SEMAPHORE TBOX

TBOX -WM -LP

User's Guide
Wiring & Technical Specifications

Version 2.08

Disclaimer

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Important Safety Instructions

Read and understand all instructions. Save these instructions.

Safety Instruction when used in Hazardous Location

- **WARNING:** USE ONLY BATTERY PACK, reference **ATEX-BAT-PACK**
- **WARNING:** DO NOT OPEN THE BOX IN EXPLOSIVE ATHMOSPHERE
- **WARNING:** DANGER OF POTENTIAL ELECTROSTATIC CHARGE. CHECK THERE IS NO GAZ BEFORE TOUCHING THE CABINET

- Read the instruction manual carefully before using the equipment and comply with the instructions that it contains to avoid mistakes and to prevent any personal injury or damage to property.
- **Warning !** It is mandatory that this equipment is earthed by the rack or IP68 enclosure. Connect the crimp terminal ring to the earth with a stranded wire between 1.5 and 2.5 mm^2 inclusively. The cable must be crimped consistent with rules of good practice.
- Installation must be carried out by suitable, competent personnel, according to the steps and stated specifications described in this manual.
- Use only the approved color-coded wires for connecting to mains. The green/yellow colored wire can be only used as earth wire.
- This equipment has been designed for use only by qualified and instructed personnel in an industrial environment. This equipment must be operated in a restricted access location according to IEC60950.
- It is a Safety Class III equipment, according to IEC classification; This equipment must be powered by a Safety Extra Low Voltage (SELV).
- This equipment has been designed to meet IEC60950-1 requirements (safety of information technology equipment)
- This equipment has been designed for indoor or for outdoor use when mounted in the IP68 enclosure. It can be used in a Pollution Degree 2 environment (dry non-conductive pollution).
- The DIN rail mounting module must be fastened to the rack using a screw driver, with a recommended minimum torque of 0.5 N.m.
- **Caution** – To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.
- Your TBox-WM and TBox-LP can be used in a wet environment if mounted in IP68 enclosure.
- Using this instrument in a way not specified by these instructions can impair the equipment safety. Do not operate the instrument outside its rated supply voltage and environmental ranges.
- Do not open power supply unit. There are no user serviceable parts inside.
- Do not connect or disconnect any connector when powered.
- Protect your TBox-WM and TBox-LP from environmental hazards such as dirt, dust, food, liquids, excessive temperature, and sunlight overexposure.
- Keep your TBox-WM and TBox-LP away from direct or excessive moisture or rain and extremely hot or cold temperatures to ensure that the TBox is used within the specified operating range.
- **Caution** – Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the local regulations.
- **Caution** – When used in hot environment, the aluminum housing may reach a temperature higher than 70°C. Take precautions when touching the housing.

Environmental Considerations

Battery Disposal

! CAUTION: There is a danger of a new battery exploding if it is incorrectly installed. Replace the battery only with the same or equivalent type recommended by the manufacturer. Do not dispose of the battery along with household waste. Contact your local waste disposal agency for the address of the nearest battery deposit site.

Your TBox-WM uses lithium battery. The lithium battery is a long-life battery, and it is very possible that you will never need to replace it. However, should you need to replace it, see chapter 3.1 and 3.2 for instructions.

General Precautions in Wiring

- To avoid **electrostatic discharge**, drain off electrostatic charges by touching a known earth immediately before handling TBox, touching front plate button, connectors or cables.
- Wiring of Inputs/Outputs, RS232 connections, GSM antennas cannot **exceed 30 m.**, neither leave the building without surge protection.
  Wiring to DC power, PSTN modem and RS485 can exceed 30 m.
- In case of DC power to a distribution network, it is mandatory to use a **surge protection**.

Certifications

ATEX II 2 G for *TBox WM*	Ex ib IIB T4-T3 (CEI/EN 60079-0 and CEI/EN 60079-11) ISSeP10ATEX 036 X
ATEX II 3 G for *TBox LP*	Ex ic IIB T4-T3 (CEI/EN 60079-0 and CEI/EN 60079-11) ISSeP10ATEX 037 X
SAFETY Metlabs	In progress
CEBEC	IEC 60950-1:2005 (2nd Edition) and EN 60950-1:2006
EMC	**EN 61000-4-2**:1995 + A1:1998 + A2:2001 **EN 61000-4-3:**2002 + A1:2002 + A2:2005 **EN 61000-4-4:**1995 + A1:2000 + A2:2001 **EN61000-4-5:**2006 **EN 61000-4-6:**1996 + A1:2000 + A2:2005 **EN 61000-4-8:**1993 + A1:2001 **EN 61000-4-11:**2004 **EN 55011:**1998 + A1:1999 + A2:2002 **EN 61326-1:**2006
FCC	CFR47: 2008 (Part15 Sub Part B)
CE	Low Voltage directive: 2006/95/EC Electromagnetic Compatibility Directive: 2004/108/EC
C-TICK	ACMA N3413

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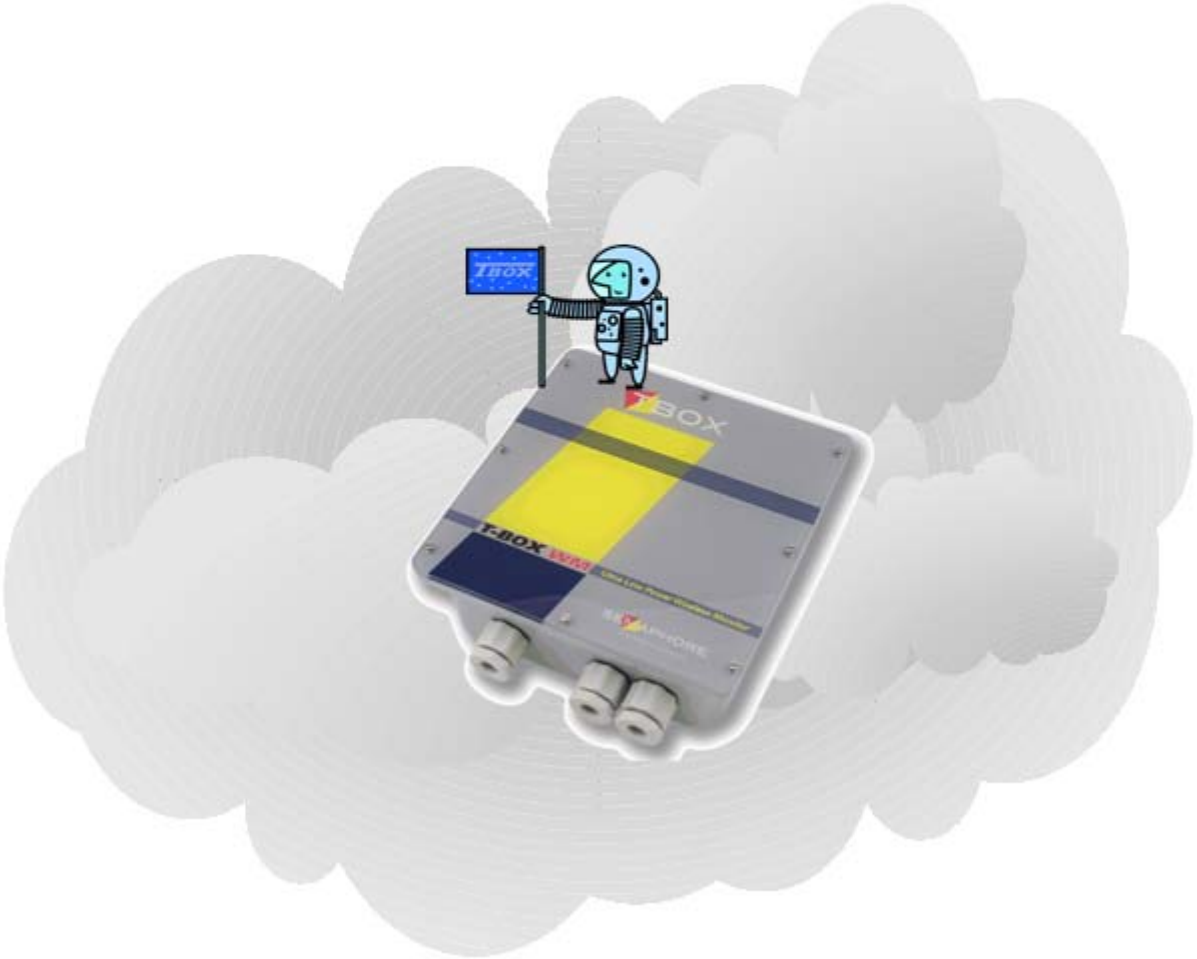
PRESENTATION

Welcome to the World of TBox WM



The unique ***TBOX ULTRA LOW POWER***, 'All-In-One' includes the best of 3 Worlds:

Telemetry

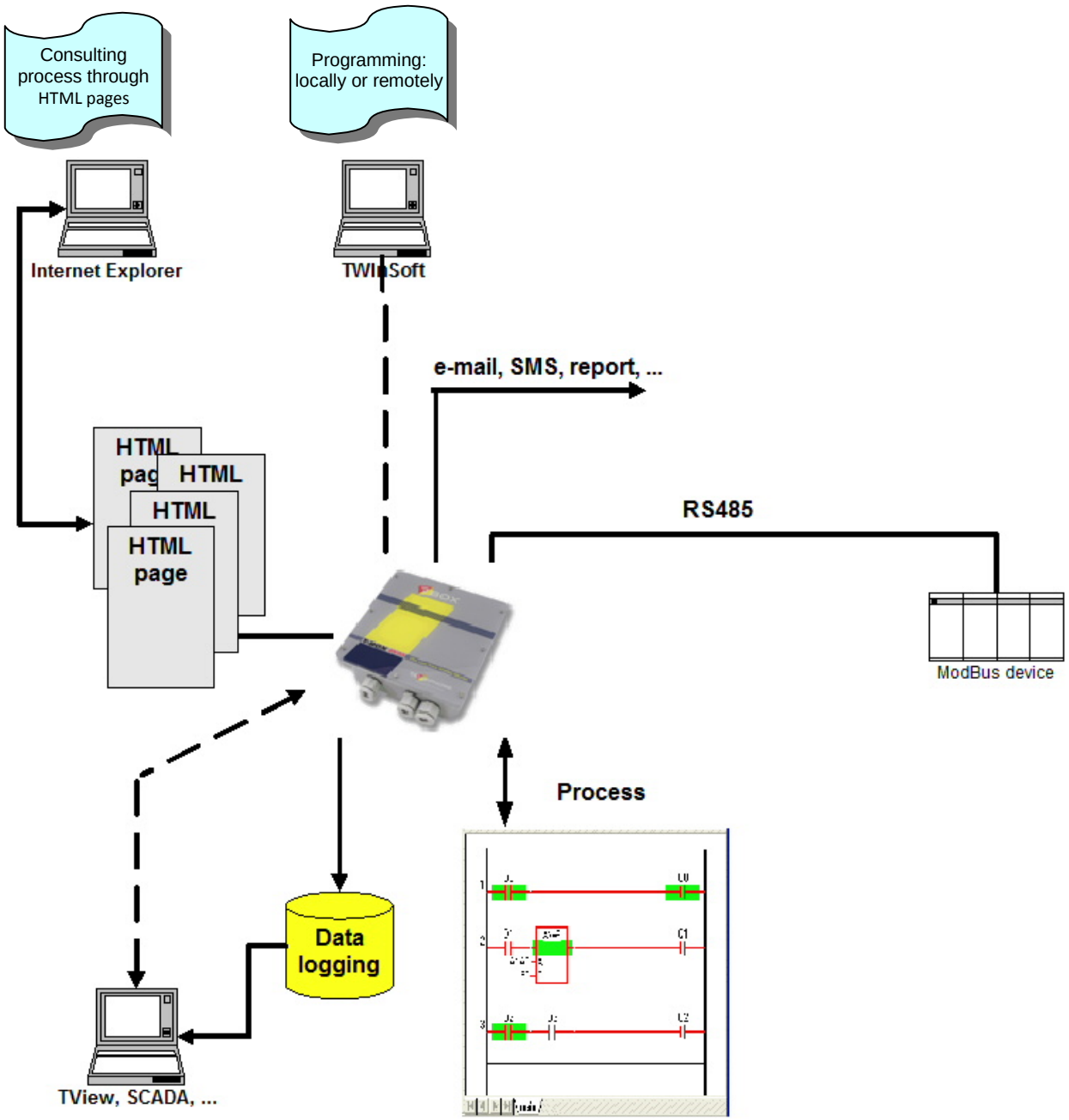
+

Internet

+

Automation

Overview of *TBOX ULTRA LOW POWER* possibilities



<u>IMPORTANT NOTE about Ultra Low Power concept</u>

Even if the features available with *TBOX ULTRA LOW POWER* are identical to other models of TBox, the fact it runs in ultra low power mode (µA consumption), imposes another way of considering telemetry. To achieve ultra low power consumption and to guarantee battery lifetime of several years, the wireless communication port will be switched off most of the time. Therefore, connection time must be reduced as much as possible, with in consequence a preference for using <u>PUSH technology</u> (sending SMS, e-mail or files) instead of classical PULL technology.
As far as Analog Input is concerned, try to use "Voltage" sensors and schedule long period between sampling (several minutes).
Process is also time consuming, then make it simple !

1. How to use this manual?

1.1. What is in the manual?

This manual contains the **essential** of ***TBox Ultra Low Power*** documentation.
It concerns two families of TBox: the ***TBox WM*** and ***TBox LP***.
To make reading easier, we will speak of ***TBox ULP*** all along the manual.

It first introduces to the **hardware concept**

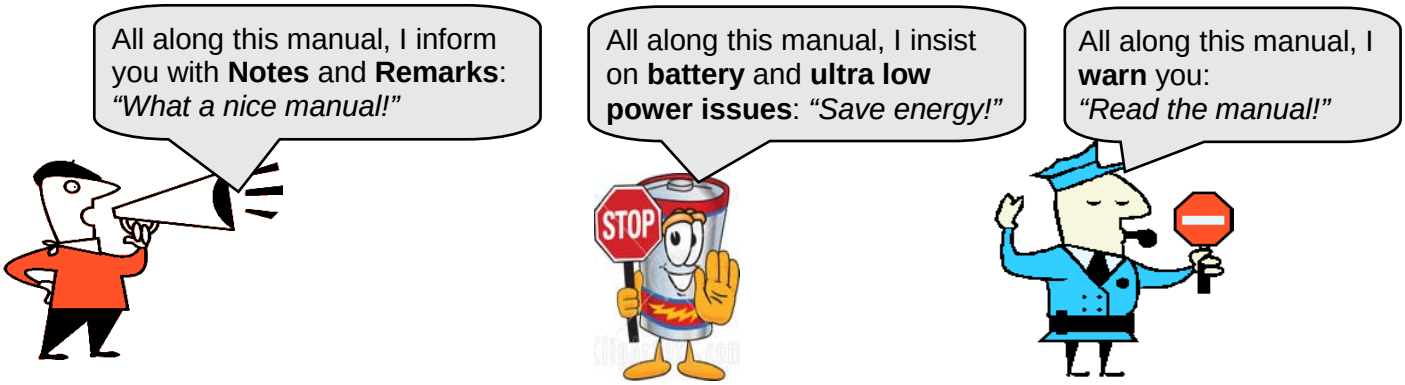
- The Ultra Low Power concept: chapter 2
- Quick overview on installing and powering: chapter 3

Then it brings you to the programming of ***TBox ULP*** using **TWinSoft**.
All features are explained using plenty of snapshots for an **easy understanding** ☺
The main topics are:

- Starting TWinSoft: chapter 5
- Properties of ***TBox ULP***: chapter 7
- Resources (CPU, com. Ports, I/O): chapter 8
- Tags: chapter 9
- IP configuration: chapter 10
- Alarms: chapter 11
- Datalogging: chapter 13
- Periodic events: chapter 15

All **technical specifications** and **wiring** are presented at **the end of this manual**.

Information related to **Licenses** is available in Appendix A.


All along this manual, I inform you with **Notes** and **Remarks**: *"What a nice manual!"*
All along this manual, I insist on **battery** and **ultra low power issues**: *"Save energy!"*
STOP
All along this manual, I **warn** you: *"Read the manual!"*

Text **highlighted** in blue concerns the use of ***TBox ULP*** in **hazardous environment**.

1.2. What is not in the manual?

One major topic you will not find in this manual concerns the programming of the process. ***TBox ULP*** supports BASIC and Ladder languages for developing any advanced process.
Those languages are detailed in **another manual**: ***BASIC and LADDER for TBOX***

Another important feature, which is not presented into this manual, concerns the development of **HTML pages**, to use ***TBox ULP*** as web server.
This matter is explained in details in **another manual: *WEBFORM STUDIO – Getting Started***
Another software part of the TWinSoft Suite is **Report Studio**, for creating e-mail report or files to send.
It is explained in the 'On line' help of Report Studio.

2. The Ultra Low Power Concept

2.1. Features

TBox WM is a ultra low power RTU, powered with Lithium battery (one or two batteries).

TBox LP is also ultra low power RTU, which can be powered with Lithium battery or external 12 V battery, typically connected to a solar panel.

With limited number of communications, the average consumption turns around 100 µA.
The typical applications are:

1. Controlled locations that are not equipped with mains (pipeline monitoring, tank monitoring, river level monitoring, avalanche monitoring, asset monitoring, ...)
2. Mobile applications.

TBox ULP is a All-In-One RTU, including a fix number of I/O and of communication ports. It is not possible to add local I/O or communication ports.

TBox ULP is also a **powerful RTU** with all the features available on all models of TBox RTU:

- Automation program (using Ladder and/or BASIC languages)
- Data logger
- Alarm generator (sending of SMS, e-mail, files,...)
- Serial protocol (Modbus-RTU, ModBus-ASCII, NMEA, ASCII)
- TCP/IP protocols: ModBus-TCP, SMTP, POP3, FTP, HTTP (through GPRS)
- WebServer embedded

TBox ULP is programmed using TWinSoft Suite.

2.2. Models

The ***TBox ULP*** is available in different hardware versions.

Product numbering syntax: **WM- <I/O>-<Com><Housing><LCD><Gas Location>**
LP- <I/O>-<Com><Housing><LCD><Gas Location>

Examples:

WM-100-GD00:(with GSM, DIN rail mounting, without LCD, normal location)
WM-200-GM01(with GSM, IP68 enclosure, without LCD, ATEX zone 1)

2.2.1. I/O Options

Reference	Power Supply	DI	DO	AI (12 bits)
WM-100	3.6 V Lithium battery	4	4	-
WM-200	3.6 V Lithium battery	4	4	2 (4..20mA – 0..5V)
LP-400	3.6 V Lithium battery	8	8	4 (4..20mA – 0..5V)
LP450	12 VDC Lead battery	8	8	4 (4..20mA – 0..5V)

2.2.2. Communication Options

Reference	Communication
-G	GSM/GPRS
-S	Serial

2.2.3. Housing Options

Reference	DIN rail	IP68 - Aluminum
D	**√**	-
M	optional	**√**

2.2.4. LCD Display Options

Only available with the **IP68 enclosure**.

Reference	Display – 2 lines	2 buttons	5 VDC (max. 220mA)
0	-	-	-
1	**√**	**√**	**√**
5	-	-	**√**

2.2.5. Gas Location Options

With ***TBox WM***

Reference	Norm	Zone
0	**Class1, Div1**	**Explosive Atmosphere can exist all the time. Normal location**
1	**ATEX1**	**Explosive Atmospheres are likely to occur**

With ***TBox LP***

Reference	Norm	Zone
0	**Class1, Div2**	**Explosive Atmosphere are not likely to exist. Normal location**
1	**ATEX2**	**Explosive Atmospheres are unlikely to occur**

2.3. Low Power operation of CPU

To operate in ultra low power mode, ***TBox ULP*** needs specific components (hardware) but also a dedicated Operating System (firmware) to reduce consumption by monitoring 2 working modes:

- 'Sleep' mode.
- 'Awake' mode.

2.3.1. Sleep mode

Most of the time, ***TBox ULP*** runs in sleep mode. The microprocessor runs with a 32 kHz Quartz and executes few operations:

- counting and storing pulses coming on the digital inputs while in sleep mode.
- storing transitions on digital inputs
- two inputs can also act on interrupt of the microprocessor to wake up the system on demand.

2.3.2. Awake mode

At fix intervals, ***TBox ULP*** wakes up to carry on several tasks and check various items since the last wake-up:

- reading the amount of pulses at the digital inputs.
- checking the transitions on inputs.
- checking the period for powering the analog inputs.
- checking alarm conditions.
- checking data logging conditions.
- checking communication with remote device conditions.
- execution of one cycle of Ladder/BASIC.

2.3.3. Wake-up Intervals

The period between wake-up can be selected among the followings:
1sec., 5 sec., 10sec., 15 sec., 20 sec., 30 sec., 1 minute.

The bigger the period is, the smaller the consumption will be !

2.3.4. Permanent mode

In this mode, the processor never returns to sleep mode, Ladder/BASIC is executed without interruption, handling of I/O, Alarms and data logging are still executed only every second.

In this mode, the RTU does not work in low power !

We consider real **ultra low power** operation when working at a wake-up rate of 1 minute.

Any local or remote ModBus communication awakes ***TBox ULP.***
Concerning I/O changing and effect on datalogging:
- direct writing to outputs is immediately processed as well as chronologies.
- inputs and sampling tables are processed at wake-up of the CPU.

2.4. Low Power operation of GSM/GPRS

In addition to RS232 and RS485 ports, a **GSM/GPRS** communication module is available with ***TBox ULP***. The GSM/GPRS has been selected to fit low power application. In order to save as much energy as possible, this modem supports its own low power mechanism, independent from the CPU, allowing to **turn off GSM power** for any amount of time.

There are 2 possible modes that you can select from the 'Parameters' menu (see chapter 8.4.1: ***GSM/GPRS modem***).

Permanent: the modem is always ready to communicate, independently from the wake-up rate of the ***TBox ULP***

Low Power: the modem is by default unpowered. During wake-up of the CPU, the modem can be powered according to alarm with severity 'High' or with the help of communication variables [COM2.ModemPower & COM2.ModemPoT] or [COM2.ModemAlarm].
The modem can be powered independently from CPU wake-up, using "interrupt" inputs. When an "interrupt" is detected, one cycle of Ladder/BASIC is launched which can cycle the power of the GSM/GPRS using communication variables (see chapter 8.4.1).

- GSM data / GPRS: when powered, the GSM module can be either in **idle mode** or in **communication**. The GSM selected for ***TBox ULP*** has a limited consumption during idle mode, still being able to detect incoming communication.

  Example of consumption with a GSM data availability of 60 minutes per week:
  - with 55 minutes in idle: **5 mA during 55 min.**
  - with 5 minutes in communication: **132 mA during 5 min.**
  - TOTAL=**15.58 mA/h**
  - Battery lifetime of 1 battery= **5 years and 44 days**

We consider real **ultra low power** operation when GSM is working at Low Power mode, with small periods of GSM wake-up and little communication.

2.5. Low Power operation with Analog Input

A key feature of ultra low power is the control on power of analog inputs.
It is clear for everyone that with a 4..20mA sensor, the consumption may be of 20mA just for one analog input !
Therefore, ***TBox ULP*** is able to **control the power and the acquisition of the analog inputs**.
Each channel has 4 connections:

- **V out** = to power the sensor (12 VDC or 24 VDC)
- **V in** = input for 0..5 V sensor
- **I in** = input for 4..20 mA sensor
- **GND** = 0V.

At regular, predefined periods, ***TBox ULP*** powers the sensor, waits and reads the signal.

2.6. Current Consumption Estimation

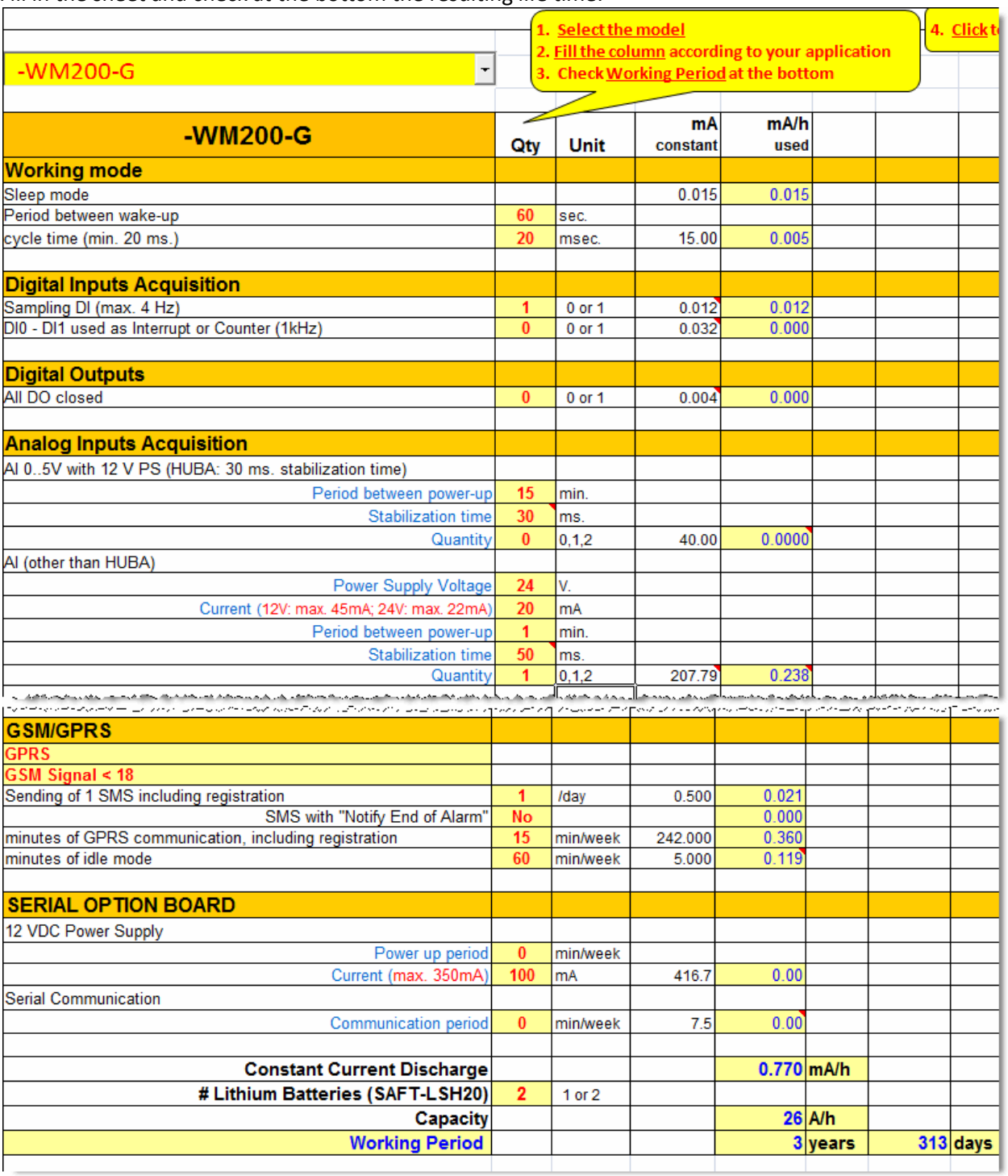
From the above description of low power operations, we can conclude that one of the major issue of an Ultra Low Power application is the current consumption of the ***TBox ULP***.

To estimate the current used and the resulting life time of the batteries, you will find in the directory of TWinSoft an EXCEL sheet: ***Consumption_ULP_x.xx.xls***

TO RUN PROPERLY THE EXCEL SHEET, MAKE SURE MACRO ARE ACTIVATED IN EXCEL.

2.6.1. Battery Life Time Estimation in EXCEL

Fill in the sheet and check at the bottom the resulting life time:



1. Select the model
2. Fill the column according to your application
3. Check Working Period at the bottom

4. Click t

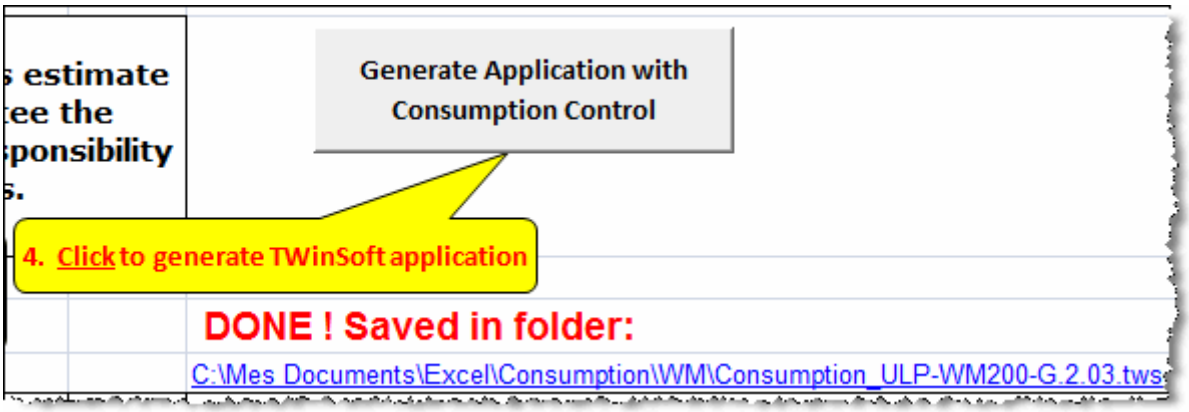
-WM200-G

-WM200-G	Qty	Unit	mA constant	mA/h used			
Working mode							
Sleep mode			0.015	0.015			
Period between wake-up	60	sec.					
cycle time (min. 20 ms.)	20	msec.	15.00	0.005			
Digital Inputs Acquisition							
Sampling DI (max. 4 Hz)	1	0 or 1	0.012	0.012			
DI0 - DI1 used as Interrupt or Counter (1kHz)	0	0 or 1	0.032	0.000			
Digital Outputs							
All DO closed	0	0 or 1	0.004	0.000			
Analog Inputs Acquisition							
AI 0..5V with 12 V PS (HUBA: 30 ms. stabilization time)							
Period between power-up	15	min.					
Stabilization time	30	ms.					
Quantity	0	0,1,2	40.00	0.0000			
AI (other than HUBA)							
Power Supply Voltage	24	V.					
Current (12V: max. 45mA; 24V: max. 22mA)	20	mA					
Period between power-up	1	min.					
Stabilization time	50	ms.					
Quantity	1	0,1,2	207.79	0.238			
GSM/GPRS							
GPRS							
GSM Signal < 18							
Sending of 1 SMS including registration	1	/day	0.500	0.021			
SMS with "Notify End of Alarm"	No			0.000			
minutes of GPRS communication, including registration	15	min/week	242.000	0.360			
minutes of idle mode	60	min/week	5.000	0.119			
SERIAL OPTION BOARD							
12 VDC Power Supply							
Power up period	0	min/week					
Current (max. 350mA)	100	mA	416.7	0.00			
Serial Communication							
Communication period	0	min/week	7.5	0.00			
Constant Current Discharge				0.770	mA/h		
# Lithium Batteries (SAFT-LSH20)	2	1 or 2					
Capacity				26	A/h		
Working Period				3	years	313	days

2.6.2. Application Generation

The EXCEL sheet provides also the generation of a ***TBox ULP*** application, including battery life time calculation.
Click the button and it automatically generates an application with calculation of current consumption corresponding to the data filled in the EXCEL sheet.

To monitor battery consumption, **it is highly recommended to start your own application from this document.**



Example of a list of Tags of an application:

	Name	V...	Address	Type	Comment
	Add a tag				
1	SeeComment		DIV00000	Bool	FIRST use and BATTERY replacement -> Set Current=0
2	_		DIV00001	Bool	**********
3	Current_Sleep		AIV00000	Float	Estimation of current used during sleep mode
4	Current_SMS		AIV00001	Float	Estimation of current used to send SMS
5	Current_COM		AIV00002	Float	Estimation of current used by modem in Tx/Rx data
6	Current_Idle		AIV00003	Float	Estimation of current used when modem in Idle mode
7	Current_CPU		AIV00004	Float	Estimation of current used by the CPU in fast mode
8	Current_Probe		AIV00005	Float	Estimation of current used by the AI sensors
9	Current_TOTAL		AIV00006	Float	Estimation of TOTAL current used by the TBox WM
10	BatteryUse		AIV00007	Float	Percentage of battery already used
11	Battery		AI.0.1.0	Float	Battery Voltage
12	BatMin_Value		AIV00008	Float	Minimum Voltage of the battery Recorded
13	BatMax_Value		AIV00009	Float	Maximum Voltage of the battery Recorded
14	BatMaxMinDelta		AIV00010	Float	Delta between Max. and Min. Voltage of the battery
15	COM2_HookLink		COM2.HookLink	Bool	Rd:Modem Off Hook - Wr:to reset the modem
16	COM2_Answer		COM2.Answer	Bool	Modem connected in answer mode
17	GsmPwr		COM2.ModemPower	Bool	To power the modem manually
18	COM2_ModemState		COM2.ModemState	Byte	State of the modem
19	CPUUsage		CPUUsage	DWord	Number of seconds of CPU activity
20	SMS		DIV00002	Bool	Sending of SMS
21	SendData		DIV00003	Bool	Sending of data
22	StateResetModem		DIV00004	Bool	State of timer used to reset modem

2.6.3. Battery Consumption Monitoring

There are 2 ways of checking battery consumption. Both can be used together in order to improve the battery monitoring.

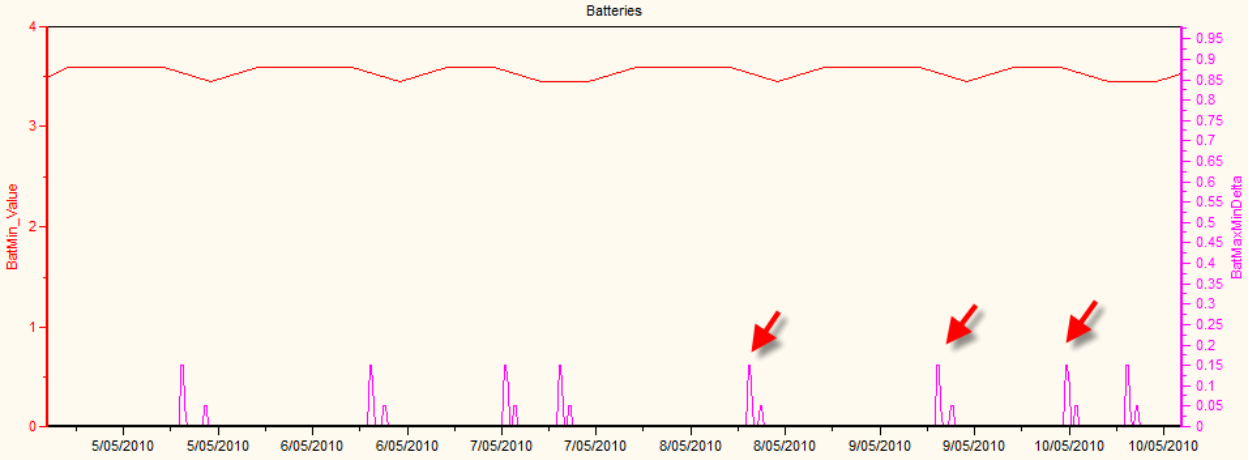
- Using a estimation, based on an addition of the different currents. The result is available in the variable "BatteryUse"

Piece of BASIC code:

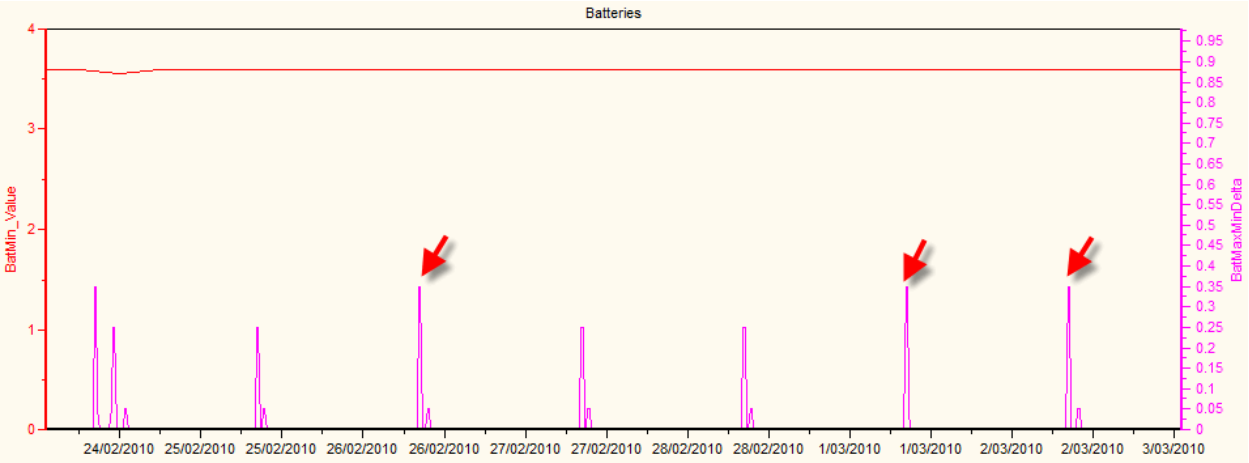
```
'#########################################################################
'Estimation of battery consumption  in mA/h
'#########################################################################

 'Calculating current in sleep mode. Current added each hour.
 ' =SleepCurrent + DiCurrent + FastDiCurrent
 '---------------------------------------
 'Calcucating Probes current - Current added each hour.
 'AVG current Probe1=40 mA; AVG current Probe2=207.79 mA
 '14 ms. to be added to stabilization time for oversampling
 '-------------------------------------------------------
 Dim UTCTemp As Dword
 Dim CurrentProbe1 As Single
 Dim CurrentProbe2 As Single

'Qty * ProbeCurrent * (StabilTime + 14ms)/1000ms/60s/ReadFreq.min
 CurrentProbe1= 0 * Csng(40) * (30 + 14)/1000/60/15
 CurrentProbe2= 1 * Csng(207.79) * (50 + 14)/1000/60/1

 If Triggerpos(Prgrun!) Then UTCTemp = UtcTim!
 If Triggerpos(UtcTim! >= UTcTemp + 3600) Then
  Current_Sleep=Current_Sleep + 0.015 + 0.012 + 0
  Current_probe=Current_probe + CurrentProbe1 + CurrentProbe2
  UTCTemp = UtcTim!
 Endif

 'Calculating current when sending a SMS
 '--------------------------------------
Dim FlagPrgRun As Bool

 If triggerpos(Prgrun!) Then
  FlagPrgRun = 1
 Endif

 If triggerpos(SMS) Then '-> Sending of a SMS
  If FlagPrgRun = 0 Then 'avoid current addition at each start of the prg
   Current_SMS=Current_SMS + 0.5 * 1 ' x 2 when "Notify end of alarme"
  Else
   FlagPrgRun = 0
  Endif
 Endif
```

- Using the voltage difference between the battery in charge and the battery without charge. When the delta is regularly of 0.3 V and higher, you should consider replacing the battery.

Batteries are OK:



Batteries reach end of life:



HARDWARE

3. Installation of theTBox ULP

3.1. Installation of batteries in ATEX environment

TBox ULP runs with 3.6 V lithium batteries.

In ATEX environment, use the battery pack **ATEX-BAT-PACK**.
It contains 2 batteries with one power connection.

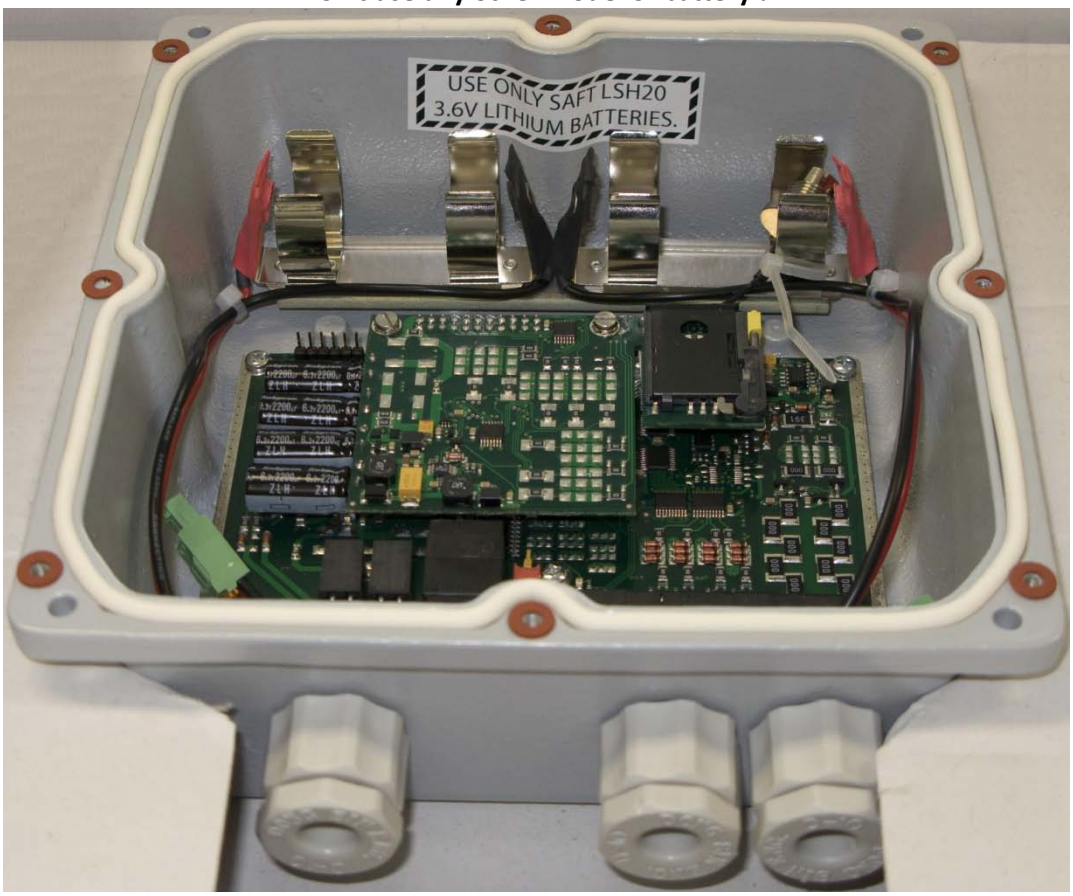
Don't use any other power means

3.2. Installation of batteries in normal and Class1 Div1 environment

TBox ULP runs with 3.6 V lithium batteries.

TBox ULP requires “High Power” battery, to support high current during short period of time when the GSM/GPRS switches on. It also requires batteries having the best performance in a large range of temperatures. The choice has been made for a model of battery providing the best efficiency: **SAFT LSH20.**

Don't use any other model of battery !



Working with IP68 enclosure, unscrew the top cover to access the battery slots.

Two slots are available. Both are in parallel.
Insert the battery with the **+** sign to the red side.

3.2.1. Replacement of the Battery in ATEX environment

Only qualified people are authorized to replace battery pack.

Use only the reference ATEX-BAT-PACK

First, connect the new battery pack to the power connection available.
Then remove the old battery pack.

3.2.2. Replacement of the Battery in Class1 Div1 and normal environment

There is no other power supply than the lithium battery. Without battery, the ***TBox ULP*** loses its datalogging and its time will restart at 01/01/70 00:00:00 GMT.
Working with one battery, place first the new battery in the empty slot then remove the old one
Working with two batteries, replace the battery one by one.

When using ***TBox ULP*** in a the Mini Rack enclosure, a separate DIN Rail enclosure contains the batteries.

Two options are available, with 1 or 2 batteries:

- Closed enclosure, see photo on the right (ref. **ACC-BAT-ENC**)

3.3. External Power Supply

During development and testing period **DON'T USE battery**. You risk to empty the battery during this period.

Use the external power supply instead of battery (ref. **ACC-PS-ULP-3.3V**)

3.4. Mounting TBox-WM in Mini Rack enclosure

TBox ULP is mounted on a mini rack equipped with **one spring** for DIN rail fixing.

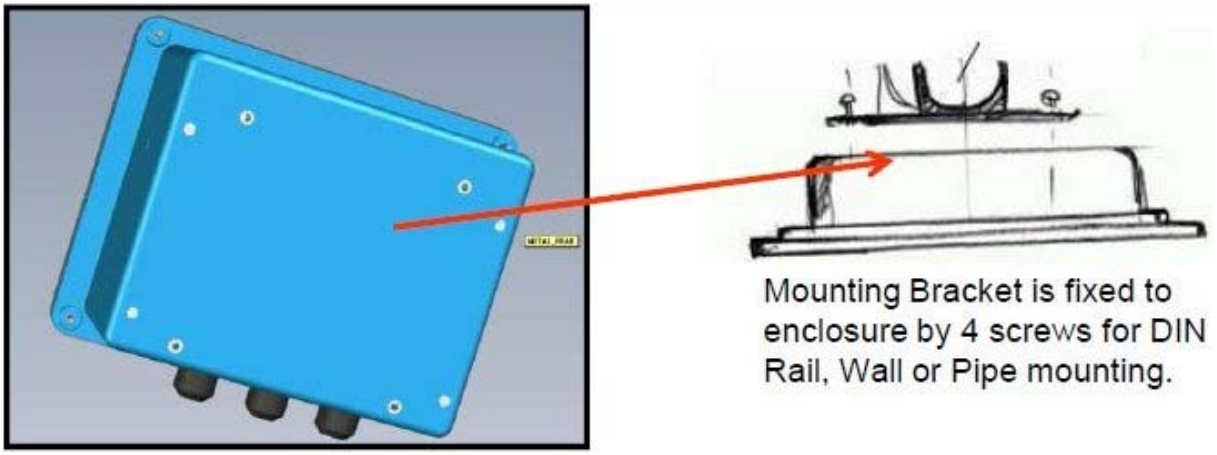
To fix it on a DIN rail:

1. Place the spring of the Rack under the bottom side of the DIN rail and pull-up the ***TBox ULP***.
2. Push the ***TBox ULP*** against the DIN rail

3.5. Mounting IP68 enclosure

The back of IP68 enclosure can fixed on different ways, using different models of bracket options:

- Wall mounting (reference: ACC-BKT-WALL)
- Pipe 2”-3” fixing (reference: ACC-BKT-PIPE3)
- Pipe 4” fixing (reference: ACC-BKT-PIPE4)



- Mounting on a wall, make sure the wall is flat
- Place the enclosure with **glands to the bottom** (see below). Check the glands are properly tightened and that **no hole is left open**.

3.6. Cable Glands

Cable glands are used to pass cable inside the enclosure.

- Cable must be round, with a diameter between 5.5 and 10 mm.
- Pass one cable per gland.
- Rear fixing nut torque: 3.5 N.m.
- Dome nut torque: 3.5 N.m

3.7. Cover

The cover is fixed with eight screws.

- Tighten properly the eight screws.
- Use a flat blade screwdriver and tighten with a torque between 2 and 3N.m.

3.8. Push-buttons (Optional)

The two optional push-buttons are fixed in the cover. Tightening the lock nut with a torque of 1.5 N.m.

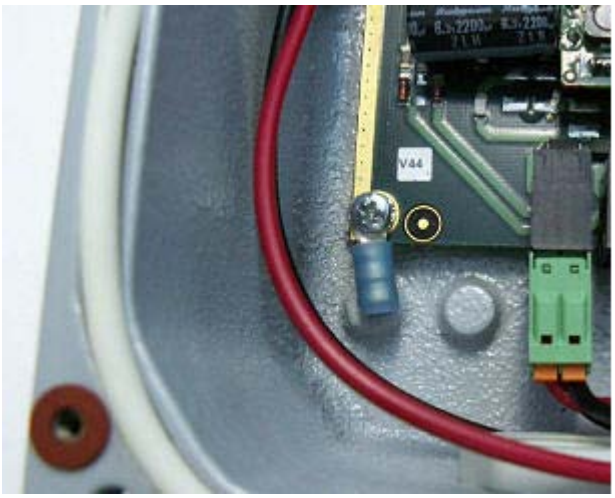
3.9. "Safety Earth Ground" Connection

3.9.1. With Mini Rack Enclosure

Each Rack is equipped with a "Safety Earth Ground" blue ring tongue PIDG. It is marked with the famous upside-down Christmas tree in a circle.

3.9.2. With IP68 enclosure

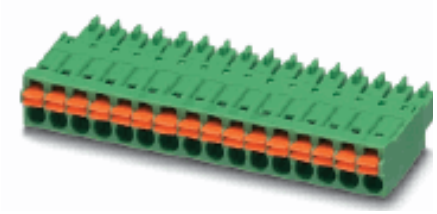
The blue ring tongue is available at one of the corners of the PCB.



You have to fasten this ring tongue to a cable and screw this ring to the rack as indicated. On the other side, you must connect the cable to the ground.
The cable must be a **2.5mm²**, colored **green/yellow** (ratio ±70% / 30%).
Be sure all connections and joints are reliably made and that Safety Earth Ground connections have no other function that connection to ground.

1. Be aware that **RS485 of TBox is not isolated**. If connecting several devices together, be sure they use **the same ground connection**; otherwise, you have to use **ACC-RS485** (contact your local TBox distributor)
2. If the environment is very **noisy**, like for instance with the presence of a **frequency variator**, be sure :
   - the connection to earth stake is **as short as possible**
   - to **separate the connection of TBox to ground** from other devices
   - not **to mix AC cabling** with low voltage DC cabling

3.10. Wiring

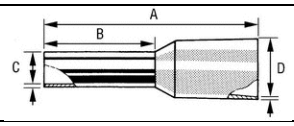


TBox ULP is equipped with compact **spring-cage terminal blocks**.
This connector allows a high density of connections.
Press the orange plastic with a screwdriver **to insert or remove the cable**.

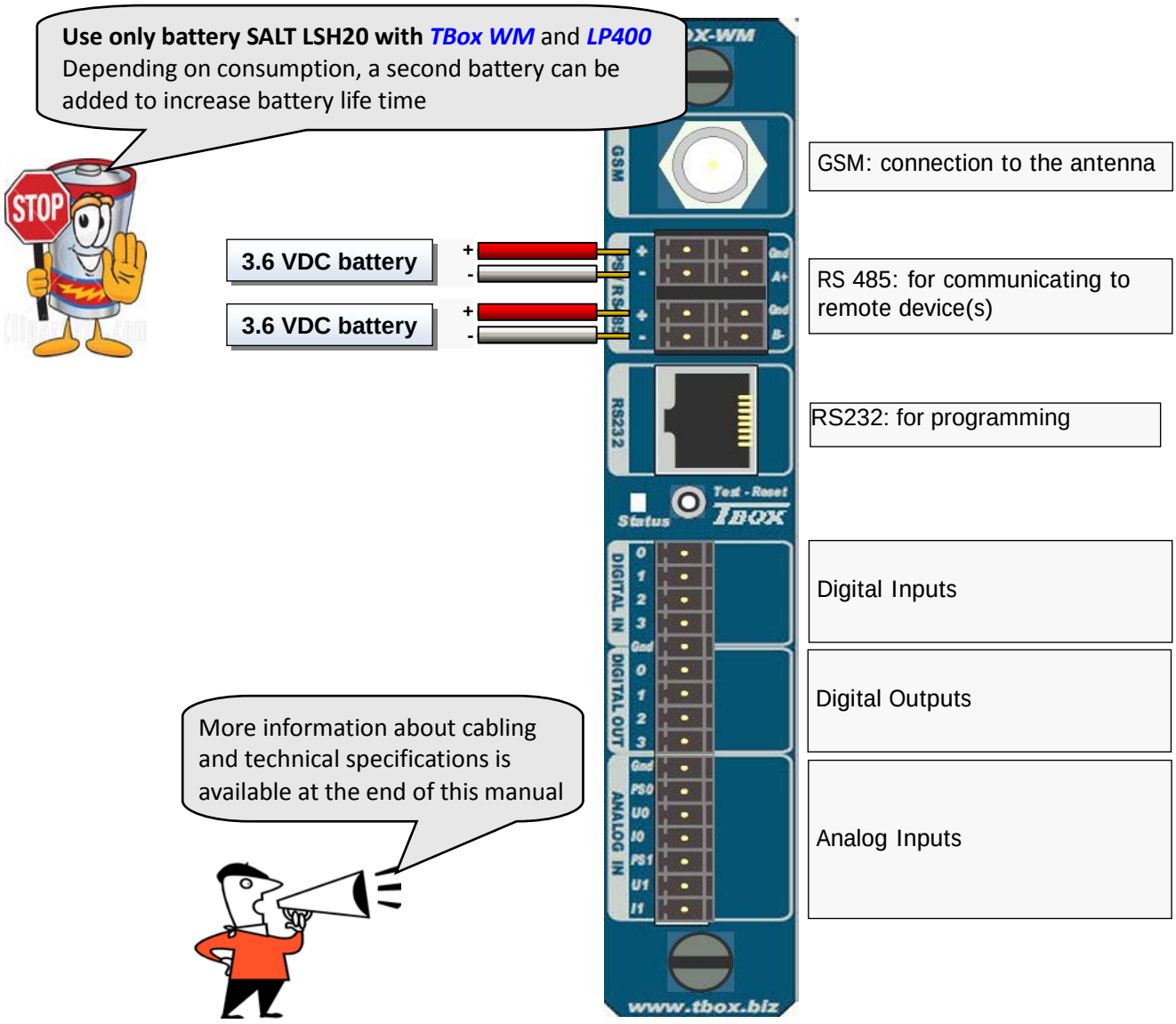
Connection capacity

Without cable shoe	Solid cable: 0.2 .. 1.5 mm² (24..16 AWG)
With cable shoe without plastic sleeve	Solid or Stranded cable: 0.2 .. 1.5 mm²
With cable shoe with plastic sleeve	Solid or Stranded cable: 0.2 .. 0.75 mm²

Ferrule specification for 0.75mm² cable

	B: **minimum 10 mm** C: 1.5 mm D: 3.5 mm	Reference: Weidmüller 9021050000

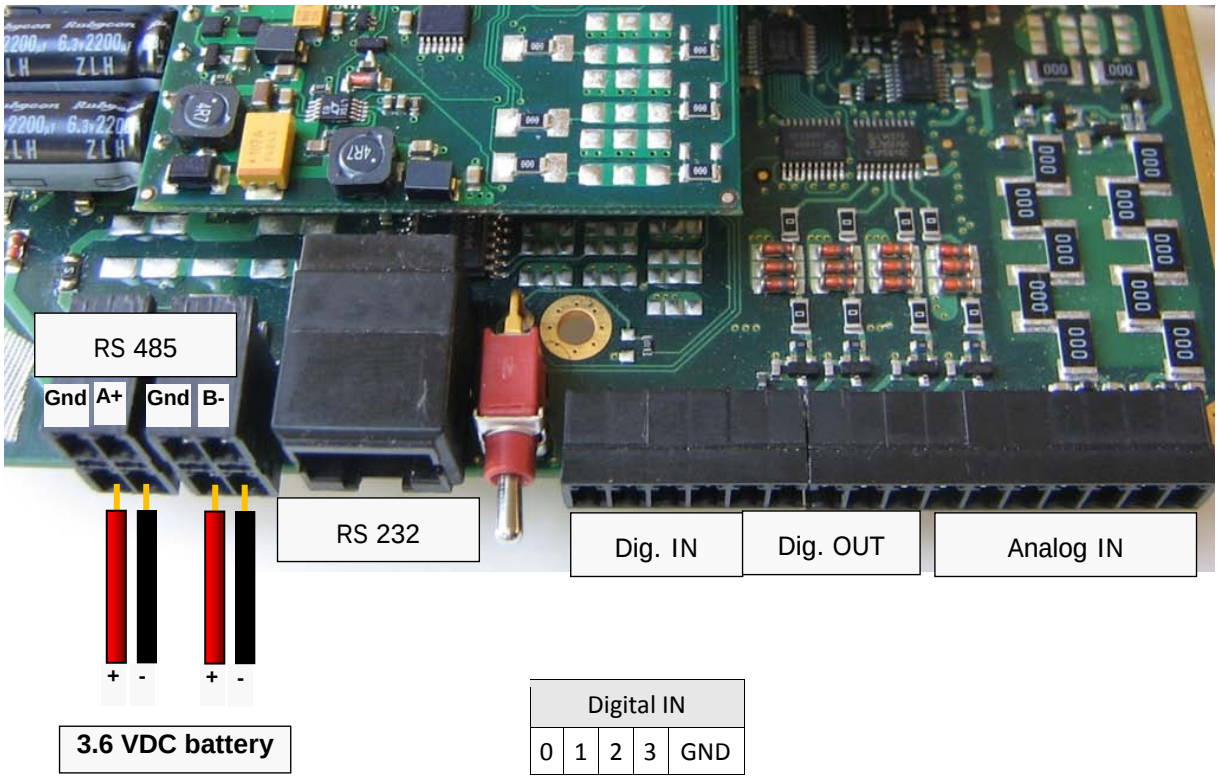
3.10.1. Wiring Mini Rack enclosure



3.10.2. Wiring IP68 enclosure

The same PCB as the one used in “mini rack” enclosure is mounted in the IP68 enclosure. Connections are identical.

Example with a WM-200



Digital IN				
0	1	2	3	GND

Use only battery SALT LSH20 with *TBox WM* and ***LP400***
Depending on consumption, a second battery can be added to increase battery life time

Digital OUT				
GND	0	1	2	3

Analog IN						
GND	PS 0	U 0	I 0	PS 1	U 1	I 1

More information about cabling and technical specifications is available at the end of this manual

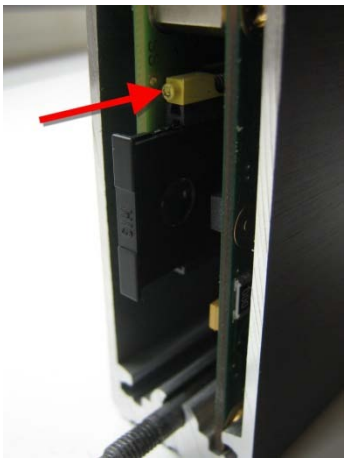
3.11. SIM card

TBox WMxxx-G and ***TBox LPxxx-G*** requires a SIM card.

It must either support GSM-DATA (including a specific DATA number to be reached) or GPRS.
The choice between GSM-DATA and GPRS will depend on the availability of your local GSM operator, the volume of ***TBox ULP*** concerned, the frequency of communications, the volume of data, …

With the **"Mini rack" enclosure**, the SIM card must be inserted at the back of the TBox.

Press the eject button of the SIM card tray and place the SIM card.



With the **IP68 enclosure**, the slot for the SIM card appears on top of the PCB.

Press the eject button of the SIM card tray and place the SIM card.

SIM card is mandatory in ***TBox WMxxx-G*** and ***TBox LPxxx-G*** . Without SIM card, the system tries to initialize the SIM card, without success. Without SIM card, the modem state machine will stop after several tries, but this still represents a useless consumption of the battery.
Check if you have an operational SIM card !

TWinSoft - Getting Started

4. Installation of TWinSoft

4.1. System requirements

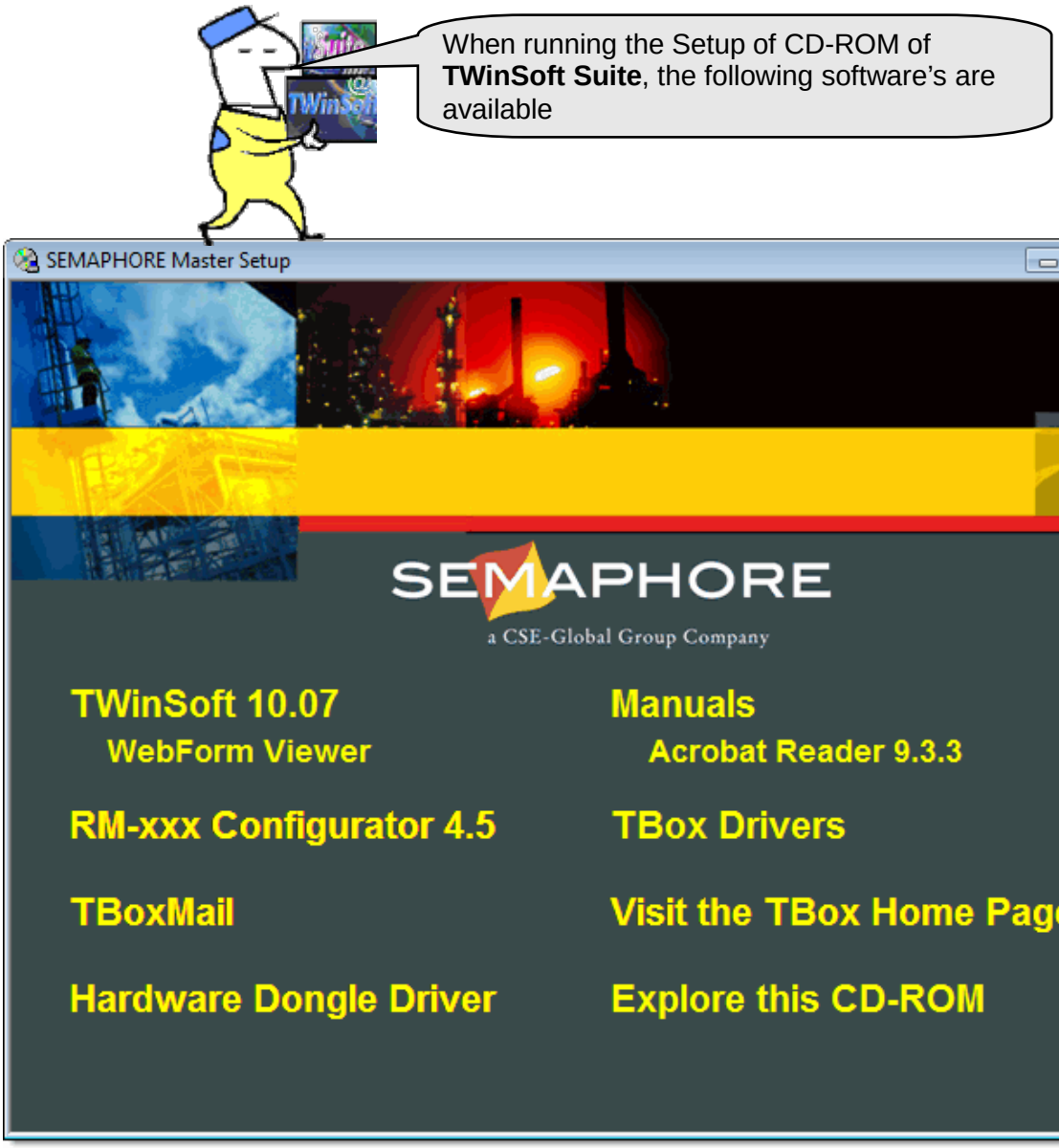
- **Hardware:** Pentium or higher.
- **Memory:** 32 MB minimum.
- **Hard Disk:** 150 MB required plus the application files.
- **Display:** VGA, SVGA with a minimum resolution of 800 x 600.
- **Mouse:** any Windows compatible mouse.
- **USB port:** required in case of license with dongle for 'USB' port.
- **Serial port:** required for a local connection to ***TBox ULP*** and/or for an external modem. If no serial port available, USB to serial adapter should be used.
- **Ethernet port:** 10/100 Mbps. Required for a connection to ***TBox ULP*** through a LAN if the ***TBox ULP*** uses GPRS.
- **Modem:** any modem properly configured in Windows.
- **Operating system:** Windows 2000, 2003, XP, VISTA, 7.

To Browse the RTU:

- **Internet Browser:** as ActiveX is used, Internet Explorer only can be used. Version 5.00 or higher is recommended to take benefit of the dialer.

The CD-ROM of TWinSoft Suite includes MSIE version 5.00.

4.2. Installation of the CD-ROM



- **TWinSoft 10.xx**

  TWinSoft is the software required for developing an application for the RTU. The basis for configuring a ***TBox ULP*** application is described in this manual.
  Installation of TWinSoft includes:
  - WebForm Studio: HTML editor dedicated to RTU
  - Report studio: Report editor dedicated to RTU
  - WebForm Viewer: ActiveX and TBox Dial it! dialer from Internet Explorer (see next).

  (**Administrator rights is required during installation**)

- **WebForm Viewer**

  This software contains the tool TBox Dial It ! uses to dial ***TBox ULP*** with Internet Explorer.
  It also contains the 'ActiveX' used to display objects dedicated to the RTU.
  It must be installed on the operator's PC to dial ***TBox ULP*** with Internet Explorer, when TWinSoft is not required.
  (**Administrator rights is required during installation**)

- **RM-xxx Configurator**
  RM are Remote Modules, based on ***TBox LITE*** architecture.
  They are programmed though an interface running TWinSoft in background.
  This entry installs this interface.
  (Administrator rights are required during installation)

- **TBox Mail**

  This software is used to display a **Chart** view from data logging attached to e-mail. To store data in a global database, you should use Tview (call your local distributor).
  (**Administrator rights is required during installation**)

- **Hardware Dongle Driver**

  In case you use a hardware dongle as TWinSoft license, you need to install this driver.

- **Manuals**

  All technical documentation about hardware and software related TBox and accessories.

- **Acrobat Reader**

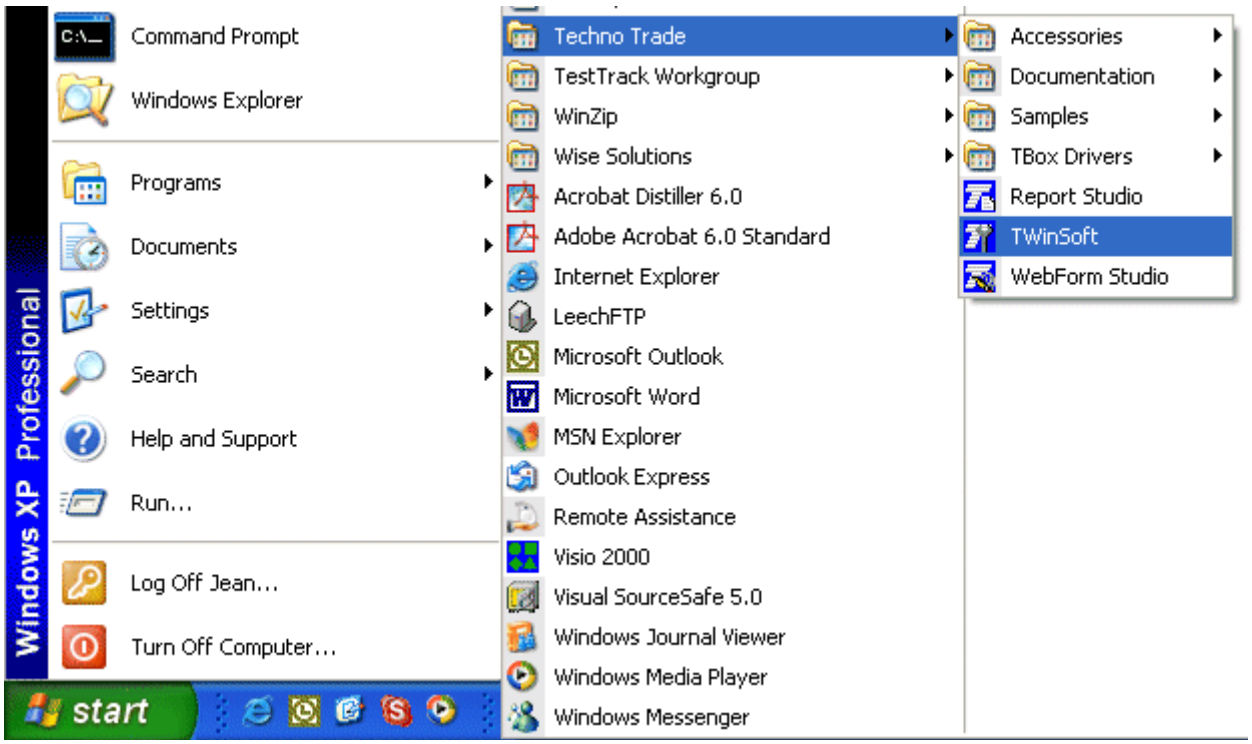
  Software needed to read our documentation.

- **TBox Drivers**

  Some features like DNP.3, IEC-60870 protocols, … are available as external drivers. The list of available drivers is available here.

4.3. Programs of 'TWinSoft Suite'

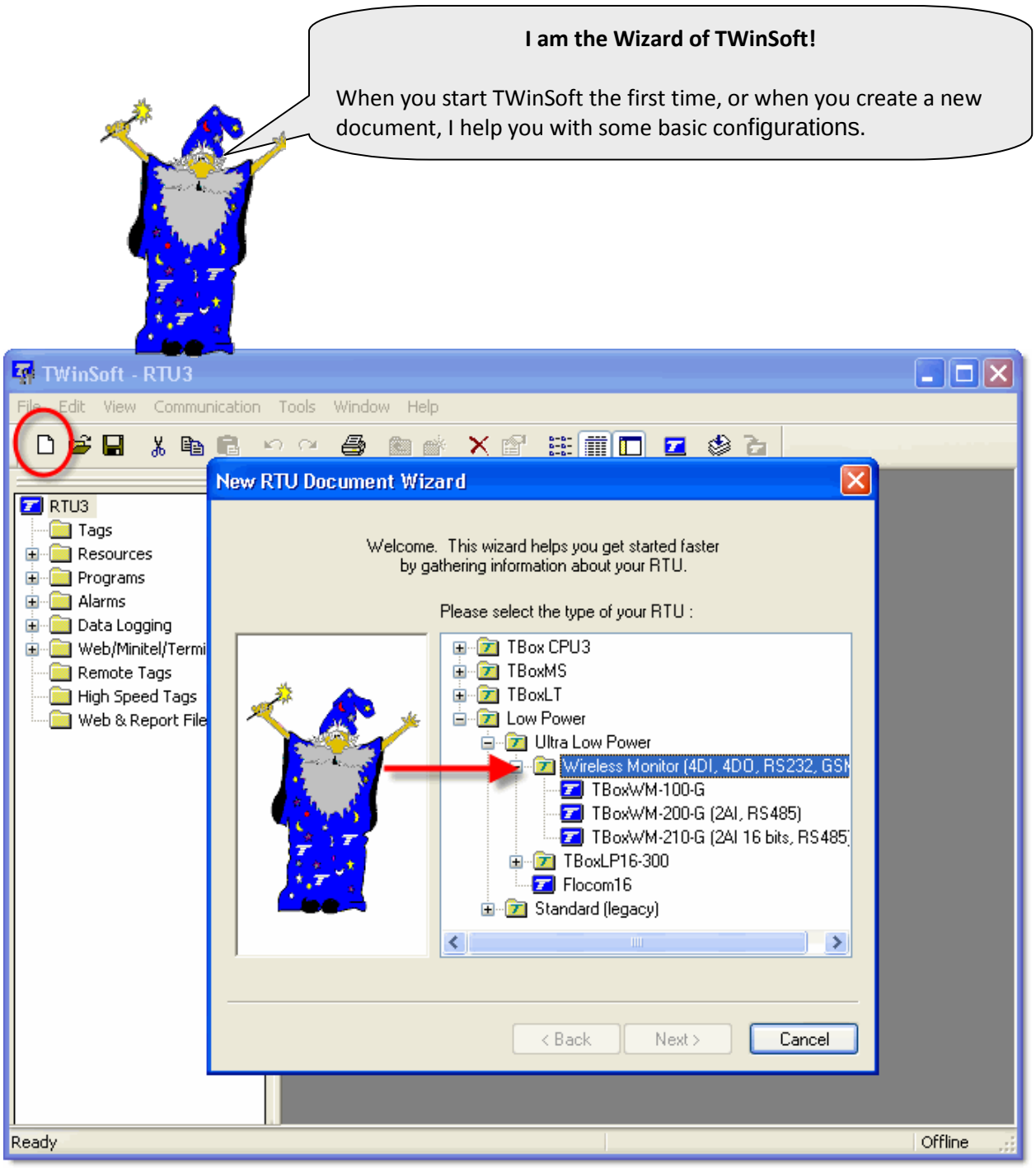
During installation of TWinSoft, a group of programs is created where TWinSoft can be started.

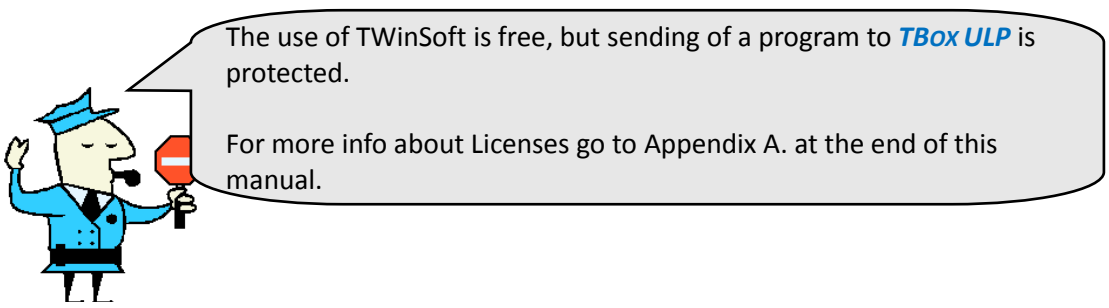


Other programs and menus:

- **Accessories:** group containing the utility 'Password generator' and 'Reset User preferences': reset of registry information to restore the default configuration of TWinSoft.
- **Documentation:** group containing various documents associated to TWinSoft and RTU.
- **Samples:** group with TWinSoft documents installed as example.
- **TBox drivers:** when 'C' custom drivers have been installed. The 'on line' help of the driver configuration is available in this folder.
- **Report Studio:** to create reports dedicated to ***TBox ULP***.
- **TWinSoft:** to start TWinSoft.
- **WebForm Studio:** to start the HTML editor, dedicated to ***TBox ULP*** when it is used as a Web Server.

5. Starting TWinSoft

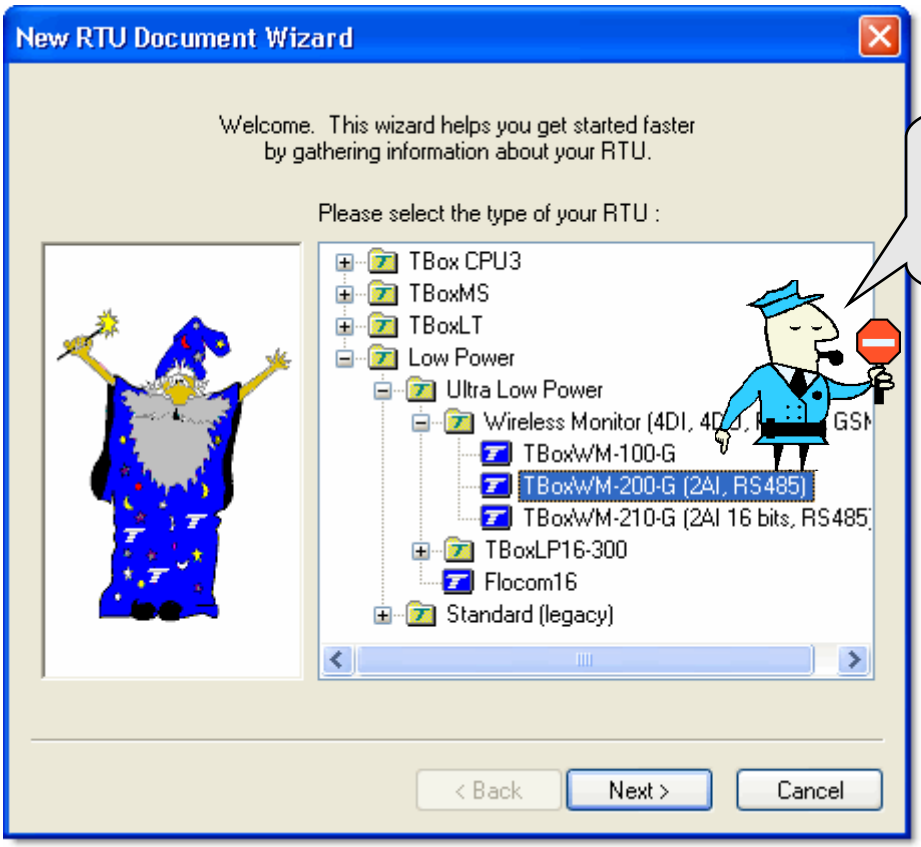



The use of TWinSoft is free, but sending of a program to TBox ULP is protected.
For more info about Licenses go to Appendix A. at the end of this manual.

5.1. Wizard

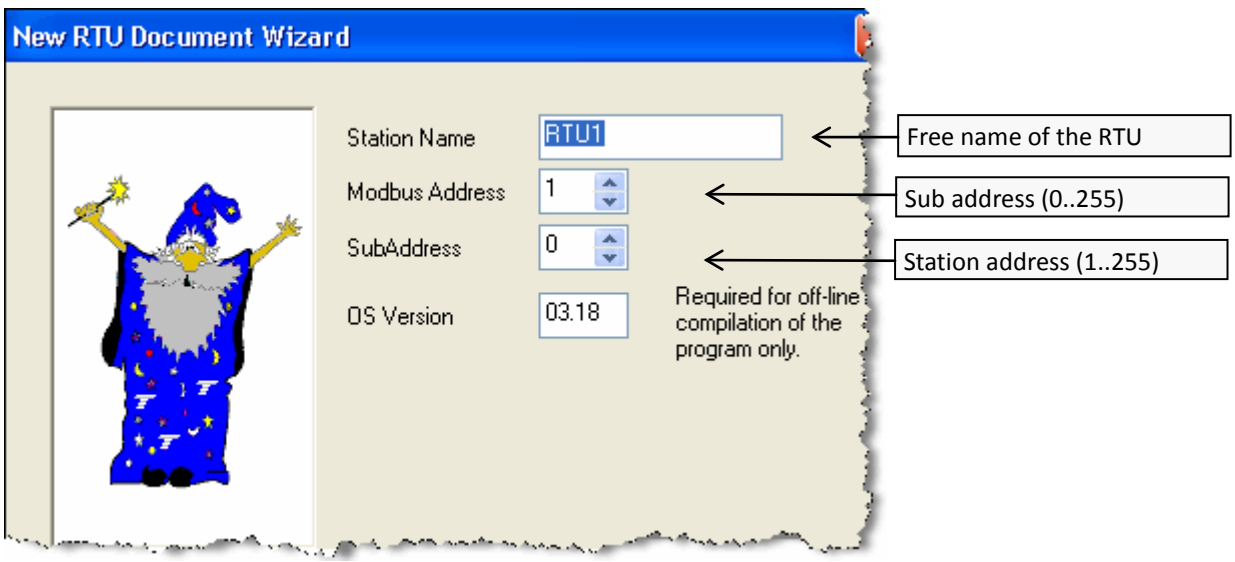
The 'New Document Wizard' helps you getting started with a new application by gathering information about your **hardware** and some **basic settings**.

Except for the 'Type of RTU', settings can be modified later from the 'RTU properties'.



According to the hardware you have, select the corresponding **family and type of RTU**.

!! You cannot change it later!!



5.2. Communicating with TBox ULP

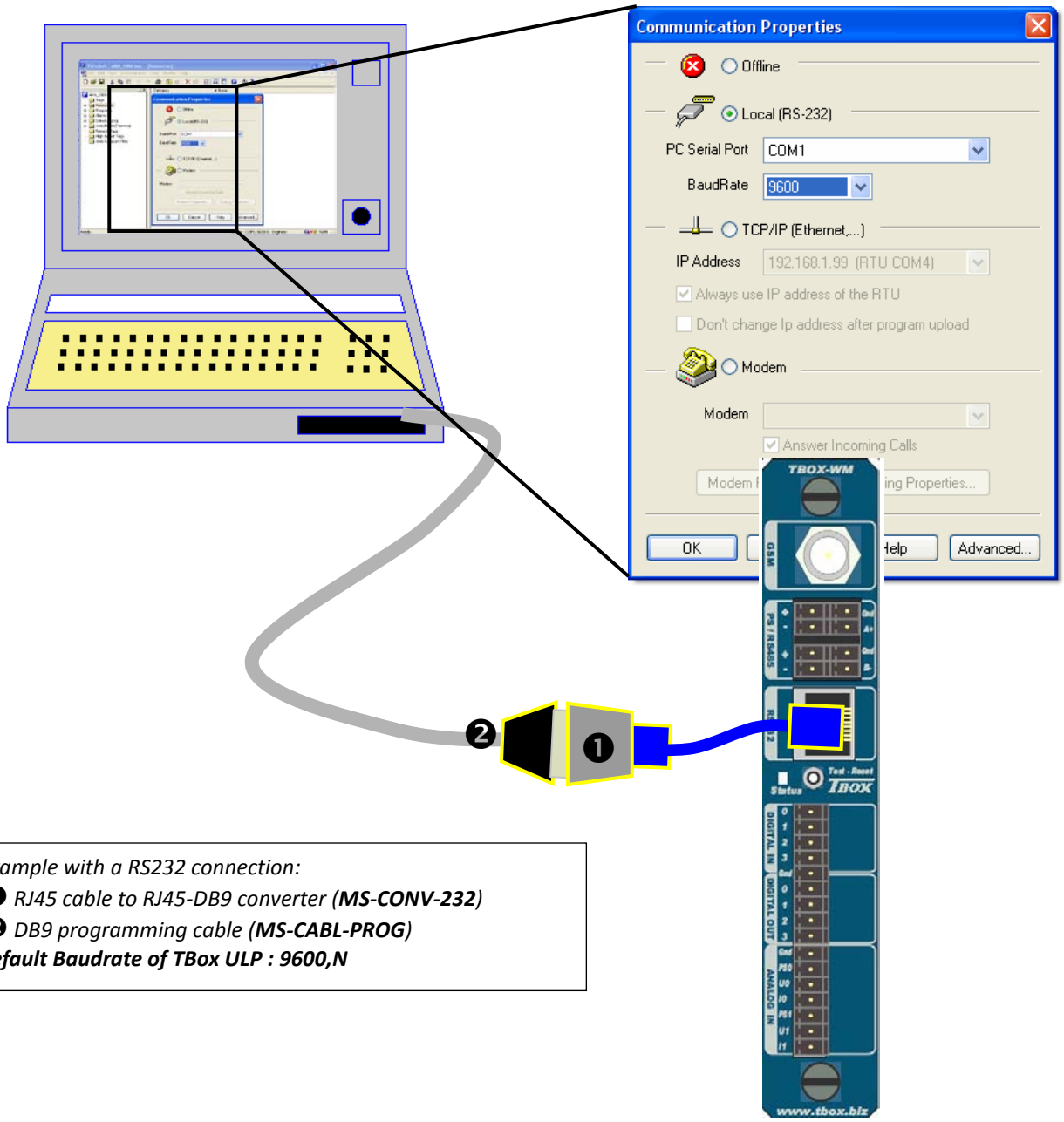
Once you have opened a document, either a new one created with the Wizard or an existing one, you can **establish the connection** with your ***TBox ULP***.

The possible communications are **serial**, **TCP/IP** or **modem**, according to the media used to connect to ***TBox ULP.***

- Serial: check the Baudrate you have given to the serial port in your application (by default 9600,N). See chapter 8.3.
- TCP/IP: to communicate to your ***TBox ULP*** through GPRS (see chapter 8.4.3).
- Modem: check the tel. Number of ***TBox ULP***.

5.3. PC Communication Set up

To communicate with the ***TBox ULP***, you need to select a communication media on the PC.
From the main menu of TWinSoft: → **Communication** → **PC Setup**:

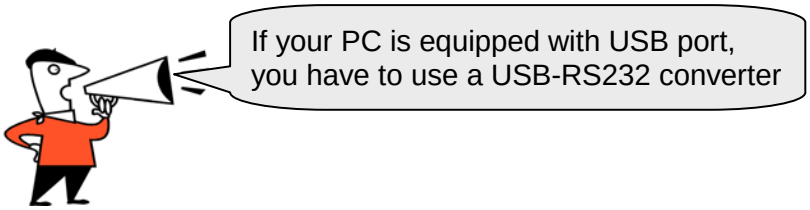


Example with a RS232 connection:
❶ *RJ45 cable to RJ45-DB9 converter (**MS-CONV-232**)*
❷ *DB9 programming cable (**MS-CABL-PROG**)*
default Baudrate of TBox ULP : 9600,N

5.3.1. Communication possibilities of TWinSoft

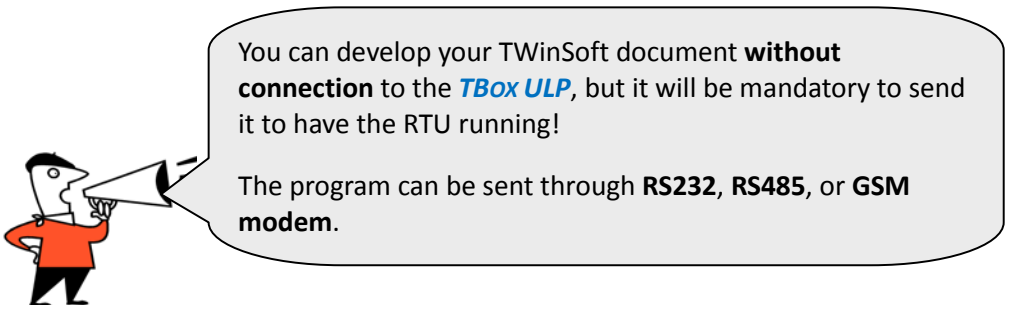
- **Offline:** this option avoid sampling ***TBox ULP***

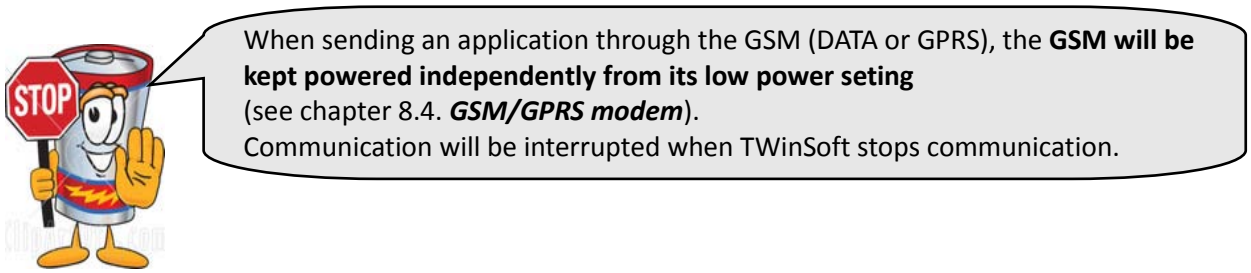
- **Local:** you select a serial port of the PC (typically RS232). The Baudrate must fit with the port of ***TBox ULP*** you are connected to.



- **TCP/IP:** to establish a communication in TCP/IP, typically to your ***TBox ULP*** configured in GPRS.
  By default, TWinSoft uses the IP address of the Ethernet (not available with ***TBox ULP***. Therefore you will have to specify another IP address, when communicating to the ***TBox ULP*** through GPRS.
  (See details chapter 5.3.2 below)

- **Modem:** to establish a remote connection to the ***TBox ULP*** when the GSM is configured in DATA mode. TWinSoft takes full advantage of Windows' built-in modem support: simply install your modem in the control panel's modems applet of Windows and you are ready to call your ***TBox ULP***.


You can develop your TWinSoft document **without connection** to the ***TBox ULP***, but it will be mandatory to send it to have the RTU running!
The program can be sent through **RS232**, **RS485**, or **GSM modem**.


STOP
When sending an application through the GSM (DATA or GPRS), the **GSM will be kept powered independently from its low power seting**
(see chapter 8.4. ***GSM/GPRS modem***).
Communication will be interrupted when TWinSoft stops communication.

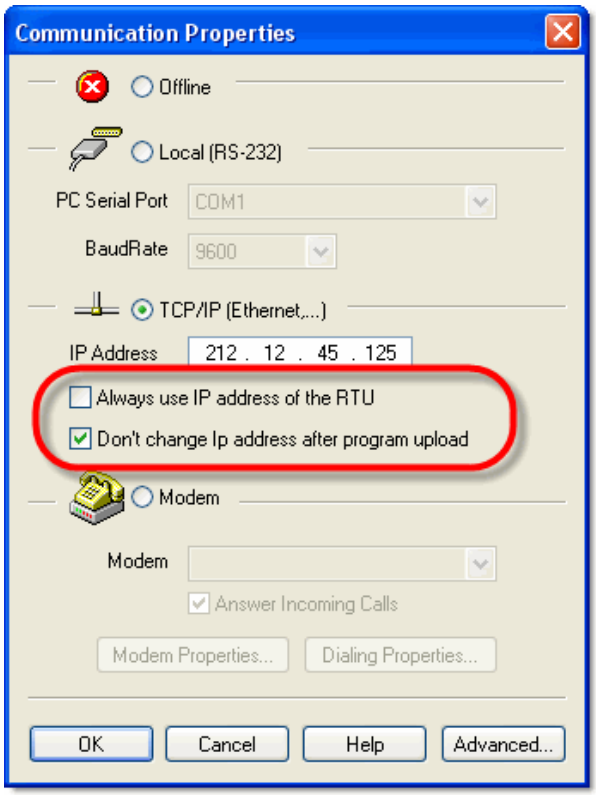
5.3.2. IP address settings in TWinSoft PC Setup

By default, TWinSoft displays the IP address of the Ethernet port of the RTU, which is not available with ***TBox ULP***. TWinSoft also automatically adapts itself to the Ethernet IP address of the RTU.
To get around the problem, as you **don't program** your ***TBox ULP*** through a **direct Ethernet connection** and **you don't want to change its IP address** use the following configuration:

Example: you access you ***TBox ULP*** through ADSL or through a direct GPRS modem.

You type **the current IP address** of the ***TBox ULP***. (see chapter 8.6.2. ***Analog Communication Variables***)

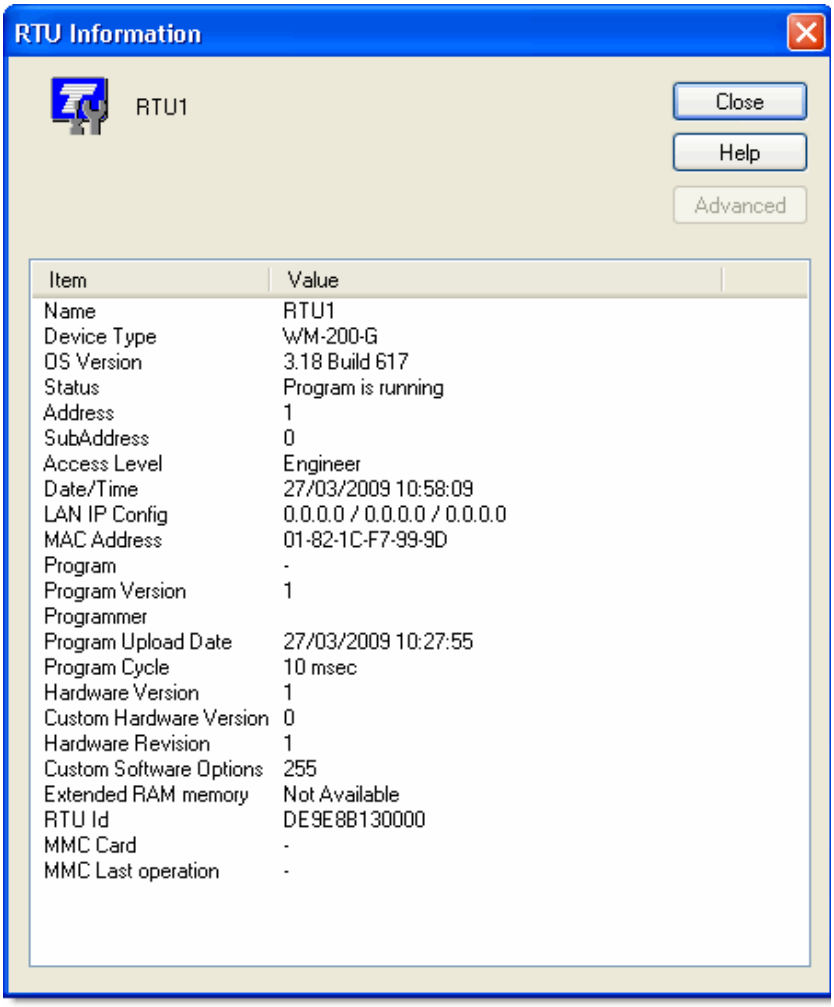
When TWinSoft has finished uploading the program, **it will not adapt itself to Ethernet IP address of the RTU (which does not exist!)**



5.4. Testing communication

Once you have selected the media on the PC, you can **test the communication**.

From the main menu of TWinSoft: **Communication → RTU identification:**



Available information:

Name of the RTU
Type of Hardware
Version of Operating System
Status of the process
ModBus address of the Station
Subaddress of the Station
Access level of the current user
Date/Time in the RTU

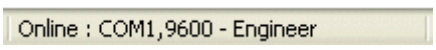
General information about the program

Process cycle time

Unique ID of the RTU

MMC / SD card not available

The **Status bar** of TWinSoft displays the status of the connection:



The communication media used by the PC is indicated as well as the access level of your connection (see chapter 16: '***Security***').

If a connection cannot be established with the ***TBox ULP***, it might be because the configuration of its port does not fit with the PC setup you use (different Baudrate, different IP address, protocol other than ModBus, …).

To set the ***TBox ULP*** to a default configuration, you have to do a **global reset** (see next).

5.5. Reset of Tbox ULP

Pressing the button 'Reset', restarts the program:
- stack of alarms and event are erased
- datalogging is maintained
- Tags with initial value are set to the value; others are maintained
- Timers are reset (status and value)
- Counters are maintained

5.6. Global reset of TBox ULP

The Global Reset is used to set ***TBox ULP*** to a default, **well-known configuration**, in case it does not communicate anymore. The program running in the CPU is stopped and ***TBox WM*** runs on the **Operating System.**
This is very useful when you take a CPU from the stock and you have no idea how the port you want to communicate with is configured.

The global reset is achieved using the **button on the front side** of ***TBox ULP***

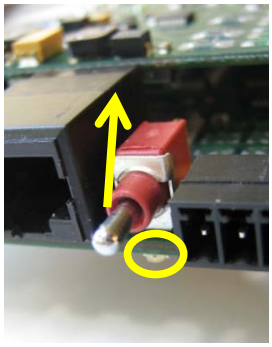
Procedure:

- Push and maintain the button to the 'Reset' side
- Let the "Status LED" flash 3 times
- Release the button

IP68 enclosure

Push up and maintain during 3 flash

LED "status" under the PCB

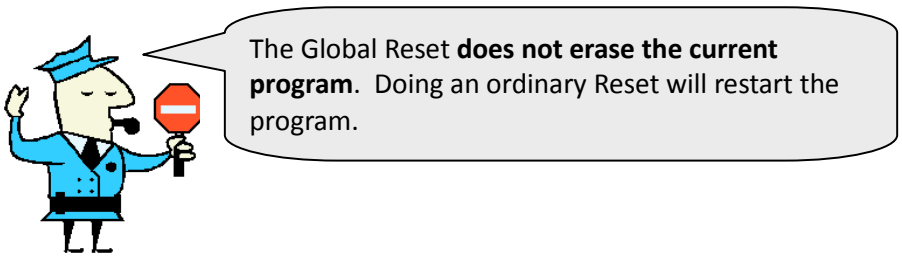


"Mini Rack" enclosure

Global reset configuration:

The global reset mode is indicated by the LED **flashing at 0.5 Hz** (instead of 2 Hz in RUN mode). In this mode, the ***TBox ULP*** is configured like following:

Port	Baudrate	Protocol	Station address	IP address
COM1 (RS232)	9600,N,8,1	ModBus-RTU	1	-
COM2 (GSM-DATA)		ModBus-RTU	maintained	-
COM2 (GPRS)		ModBus/TCP	maintained	refreshed
COM3 (RS485)	9600,N,8,1	ModBus-RTU	1	-

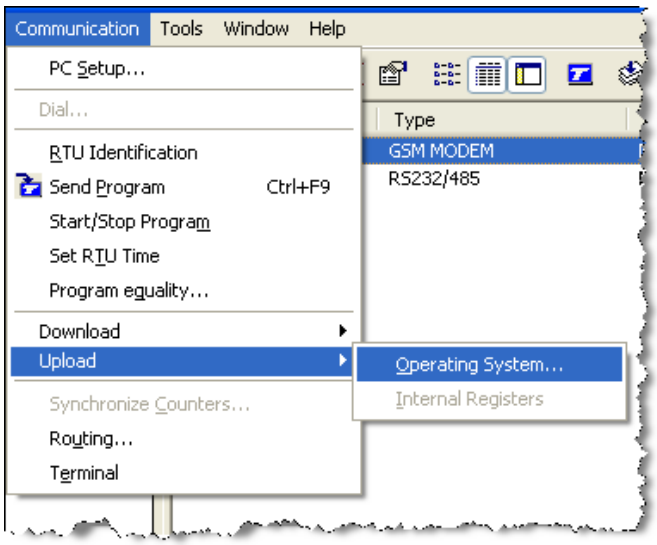


5.7. Upload 'Operating System'

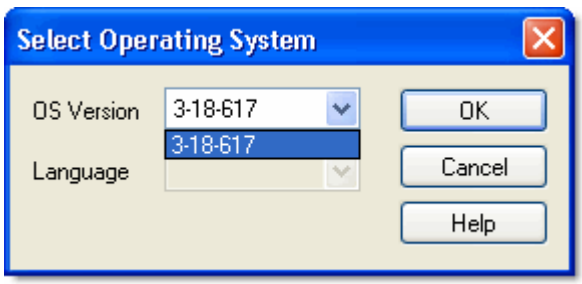
Operating System is the heart of your ***TBox ULP.***
It contains all features of ***TBox ULP***.

In some cases you might have to change this operating system, when new features are available or a bug fix released.

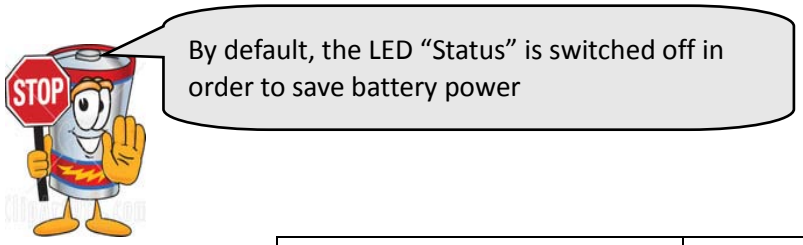
From the main menu, select 'Upload OS'



Select the highest version to use the latest features and corrections.



5.8. LED « Status »



Program runs	2 Hz
Program stopped	0.5 Hz
Operating System stopped	8 Hz

To display the working mode of the ***TBox ULP***, you have to press the button to “test” side.

IP68 enclosure

Press down the button

LED “Status” under the PCB

“Mini Rack” enclosure

5.9. Saving and Sending a Program

Like any Windows program, TWinSoft creates ‘Documents’. One document corresponds to one ***TBox ULP*** application. Each of them must be saved using the Windows standard.

5.9.1. Saving a document – Backup document

Possibilities for saving a document:

- Use the icon of the main tool bar
- From the main menu use: ‘File’ → ‘Save’
- Use the accelerator keys <CTRL + S>

Saving a document creates a file with the extension ‘.tws’ which is your TWinSoft application.
But each time a TWinSoft project ‘.tws’ is opened successfully, it is saved in a back up file ‘.tbk’. If you encounter some problem retrieving your ‘.tws’ file, you can just replace the ‘.tbk’ extension by ‘.tws’ and use the back up.

During the development of the application, it can be sent at any time to ***TBox ULP***, for testing purpose.
When sending an application to ***TBox ULP***, it is first compiled and then sent, in the same sequence.

5.9.2. Compiling an application

Compilation converts the document into microprocessor code. You can execute it:

- Use the icon of the main tool bar
- Use the accelerator key <F9>

The result of the compilation is available in the **Results window**. This windows automatically pops up when there is a problem but it can be opened manually:

- from the main menu: 'View' → 'Results'
- using the accelerator keys <ALT + 2>

The Results window provides useful data:

Information: indicated in black
Warning: indicated in bold dark green
Error: indicated in bold red

Test of memory still available

The result window also displays memory still available:

TBox ULP	**ROM: 32 kbytes**	**ROM: 512 kbytes**	**RAM: 48 kbytes**	**RAM: 72 kbytes**
Features	Application	Ladder / BASIC (64k) Sources, Web&Report	Application	Chronologies & Sampling Tables, backup of Tag values

5.9.3. Sending an application

In order to have the ***TBox ULP*** running with the program developed with TWinSoft, you have to transfer it. You can use any media to achieve it (RS232, modem, TCP/IP, …).

Possibilities for sending a program:

- Use the icon of the main tool bar
- From the main menu use: 'Communication' → 'Send program'
- Use the accelerator keys <CTRL + F9>

The sequence when sending is: Compiling + Transferring.

If a problem occurs during compilation, the sequence is stopped and the 'Results' window pops-up (see above)

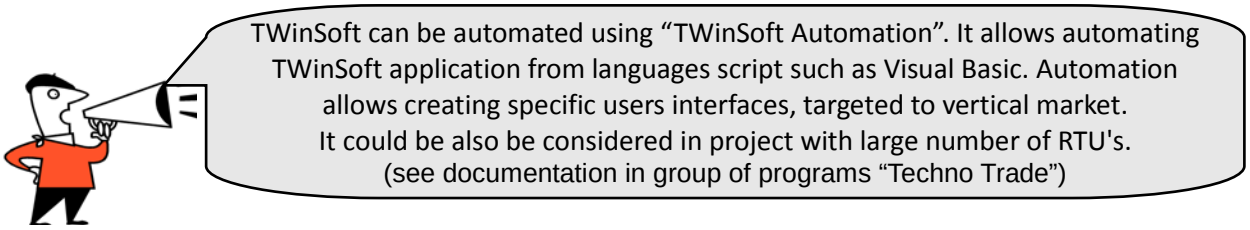
If you **interrupt the sending** of the program or an error happens before the end of sending, ***TBox ULP*** **will not restart**, even after a reset.
The reason is that the program is composed of several modules; when ***TBox ULP*** starts, it checks the integrity of these modules. When they do not correspond to the same data transfer, the program does not start, even after a reset.
You have then to re-send the program.

The good news is that ***TBox ULP*** **keeps its original settings** before it was stopped.

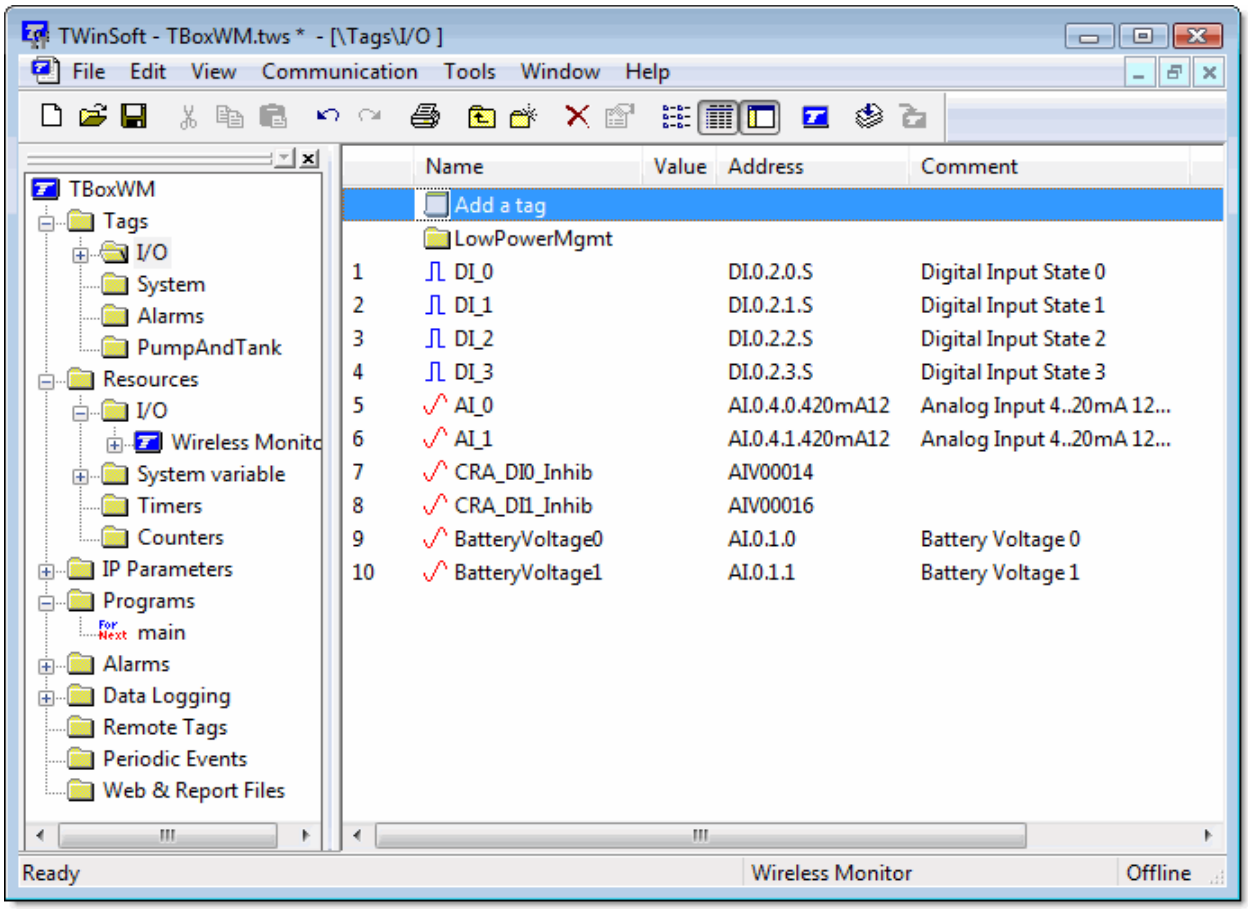
TWinSoft - Programming

6. Introduction

TWinSoft uses the standard look and feel of 'Windows Explorer'; on the left side a list of folders and on the right side the content of the folder selected.


TWinSoft can be automated using "TWinSoft Automation". It allows automating TWinSoft application from languages script such as Visual Basic. Automation allows creating specific users interfaces, targeted to vertical market.
It could be also be considered in project with large number of RTU's.
(see documentation in group of programs "Techno Trade")

In TWinSoft interface, each Folder consists in a list of items.
For instance the **list of Tags**, or in the 'Alarms' folder the **list of 'Recipients'** or in the 'Datalogging' folder the **list of 'Sampling tables'**, …



The programming of a ***TBox ULP*** application will be done in different steps:

- Configuring the **RTU properties**
- Configuring the **communication ports** and **I/O's** (from the 'Resources')
- Creating **Tags**
- Creating **Programs** using automation language Ladder and/or BASIC
- Creating **Alarms**
- Creating **Datalogging**
- If you have a Remote device, creating **Remote Tags**, to exchange data

The sequence in which those tasks are executed is not fixed, but at least RTU properties, Resources and Tags should be configured first, as being required for all other programming.

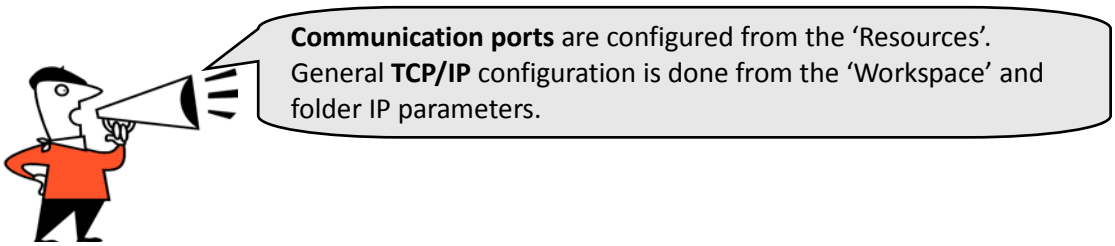
All those configurations are explained in the following chapters.

7. RTU properties

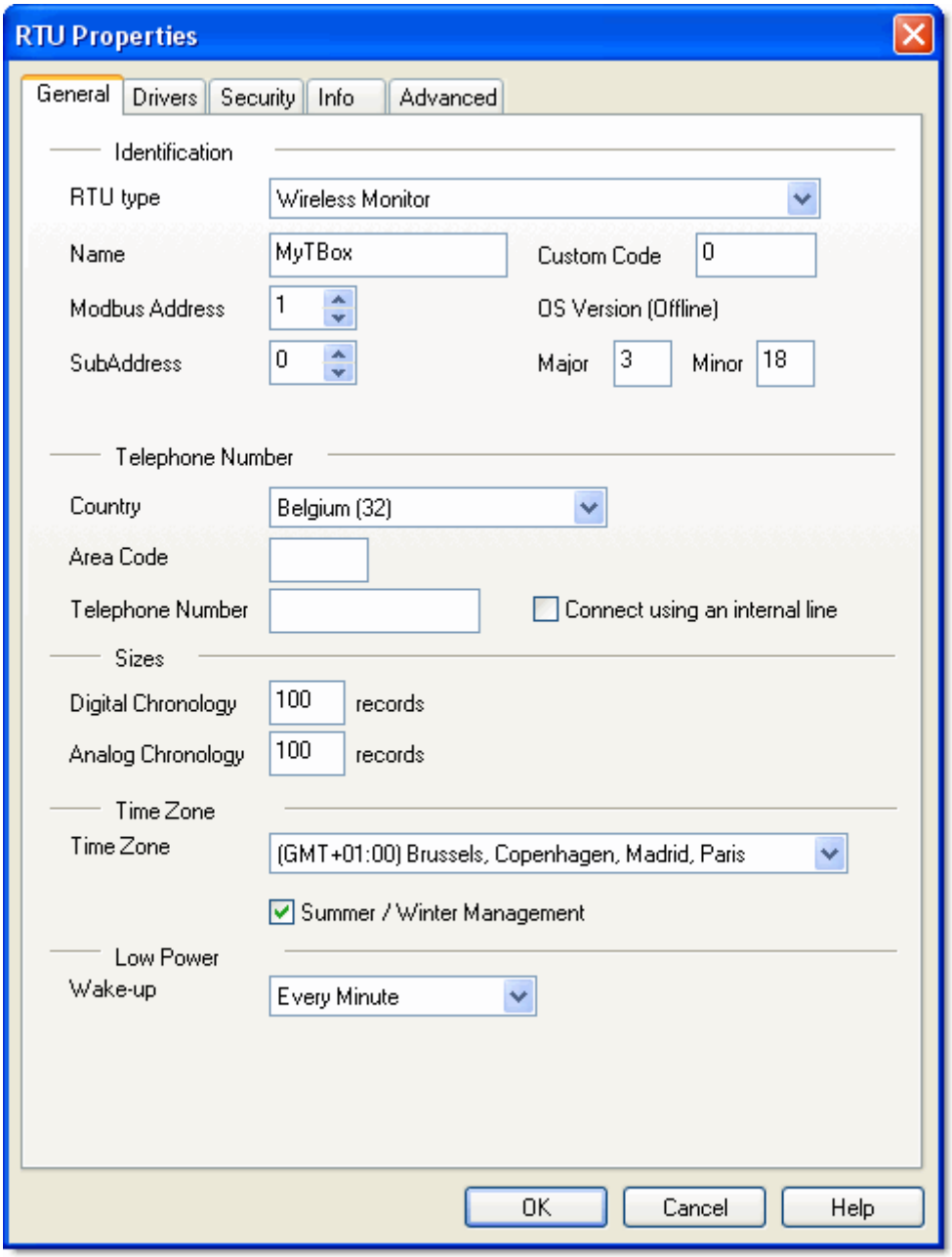
Setting the properties of the ***TBox ULP*** has never been so easy thanks to a set of comprehensive dialog boxes, available from the main tool bar.

The RTU properties are divided into:

- **General** the type of the RTU, telephone number, size of the chronologies, …
- **Drivers** configuration of external software modules written in 'C', used to execute specific task or to communicate with other protocol than standard ones.
- **Info** to type any info about your program, its different versions, …
- **Advanced** for some features, some advanced parameters are available:during start-up, when sending alarms, concerning sampling tables, …


Communication ports are configured from the 'Resources'.
General **TCP/IP** configuration is done from the 'Workspace' and folder IP parameters.

7.1. General properties



RTU Type: The type of RTU you have selected with the Wizard. **It cannot be changed !**

Name: type a free name for the ***TBox ULP***. It will be displayed when doing a 'RTU identification' and **used by the supervisory** *Tview* .
Maximum 8 characters.

ModBus address: with ModBus protocol, each device must have a **Station number**. It is its ModBus address.
Enter a number between 1 and 254 (default=1).

Sub address: if more than 254 ***TBox ULP*** must be installed in one project, you need to define a Sub address. As this is not ModBus standard, it is only supported by 'TComm.dll' based software (TWinSoft, *Tview* , … please call your distributor for further information).
Enter a number between 0 and 255 (default=0).

OS version: when **working Offline**, it is the OS used to simulate the compilation.
By default it is the OS version associated to version of TWinSoft.

Telephone number: Configuration used by TWinSoft when it needs to dial ***TBox ULP***.

Sizes: Number of records of **Digital and Analog chronologies**. The chronologies are the 'on event' method of recording data in ***TBox ULP*** (see chapter 13***: Data logging***).
Digital Chronology: max. 12 000 (Default=100).
Analog Chronology: max. 7 000 (Default=100).

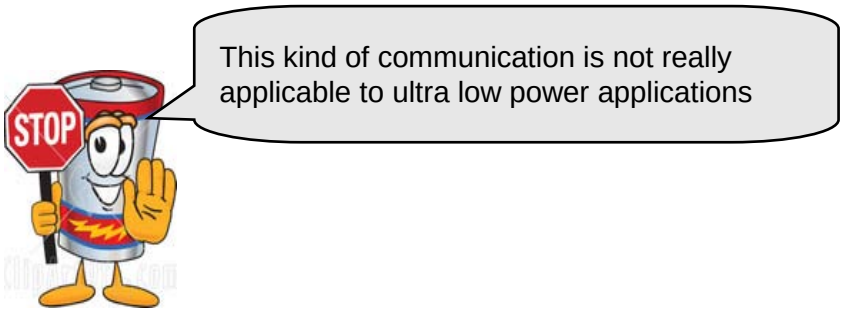
Time zone: The Time Zone **where the *TBox ULP* is installed**.
This information is used to create the time stamps when retrieving data from ***TBox ULP*** according to its location. ***TBox ULP*** uses Universal Coordinated Time (UTC) as internal time stamp. The conversion is carried out when retrieving the data.

Summer/Winter: Allows **automatic management of winter/summer time**. This selection has to be made according to the location where the ***TBox ULP*** is installed.
See Appendix B : ***Time in the RTU***

Wake-up: Determine the period between wake-ups of the CPU. See also chapter 2.3.

7.2. Drivers

A driver is a module written in 'C' that executes a specific task, non-standard.
Typically, it is communication to equipment not supporting standard protocol of ***TBox ULP***.
Standard SCADA protocols are also supported: **IEC-60870-5-101 -104**, **DNP3.0**, **TG800**, **Access Control devices**, ... Check with your distributors.



7.3. Security

Access security is discussed at chapter 16.

7.4. Info properties

You can enter a version number, the name of the programmer and a description of your program. This information is not sent to ***TBox ULP***.

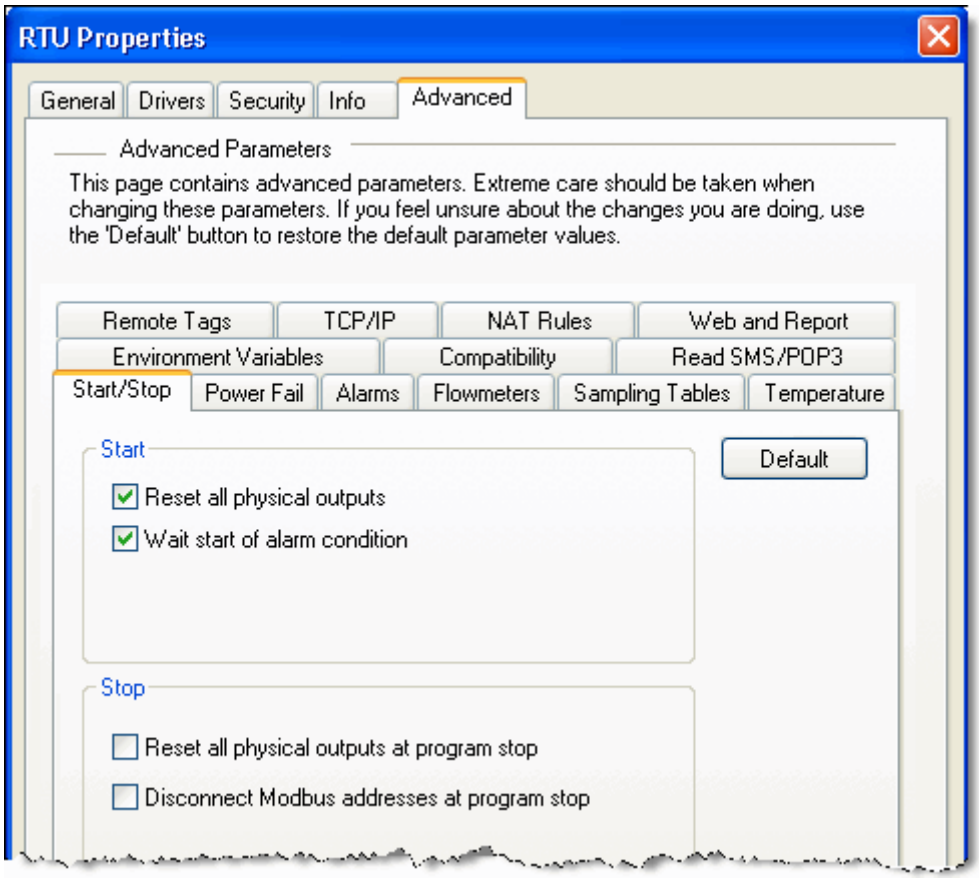
7.5. Advanced

7.5.1. Start/Stop

By Start-up we mean:

- Reset of RTU (hardware or software).
- Sending of Program

See also chapter 5.6 above



Under those conditions two mechanisms of the RTU can be customized:

START

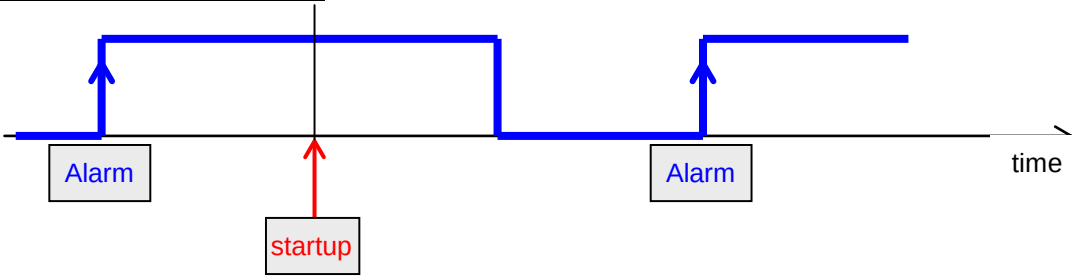
Reset all physical outputs: when **active**, at start-up the **RTU reinitializes the outputs** to '0'. After that the outputs are monitored according to the process.

When **not active**, at start-up the **outputs are maintained to their last status**. After that, outputs are monitored according to the process.

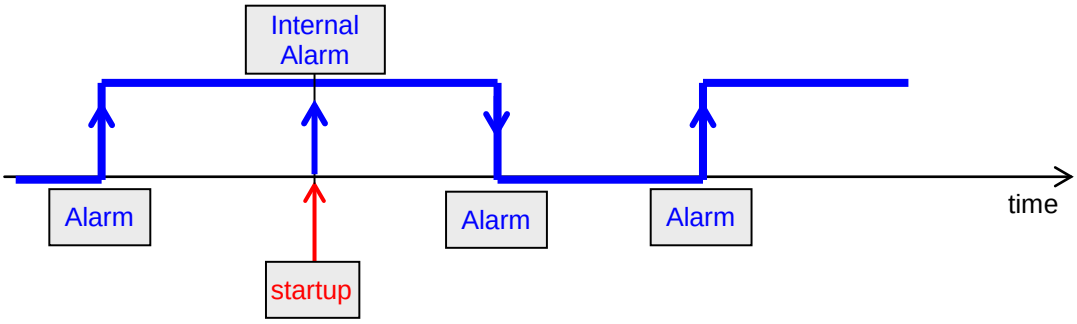
Wait start of condition: this feature relates to **alarm condition**.
The mechanism of generating alarm is based on transition: the changing of a digital Tags or the overstepping of an analog threshold.

This option allows changing this rule at start-up:

With ‘Wait start of condition’ active:



With ‘Wait start of condition’ not active: if the alarm condition is true at start-up, an internal ‘start of alarm - auto-ack’ is generated. When the alarm condition disappears, the alarm is generated.



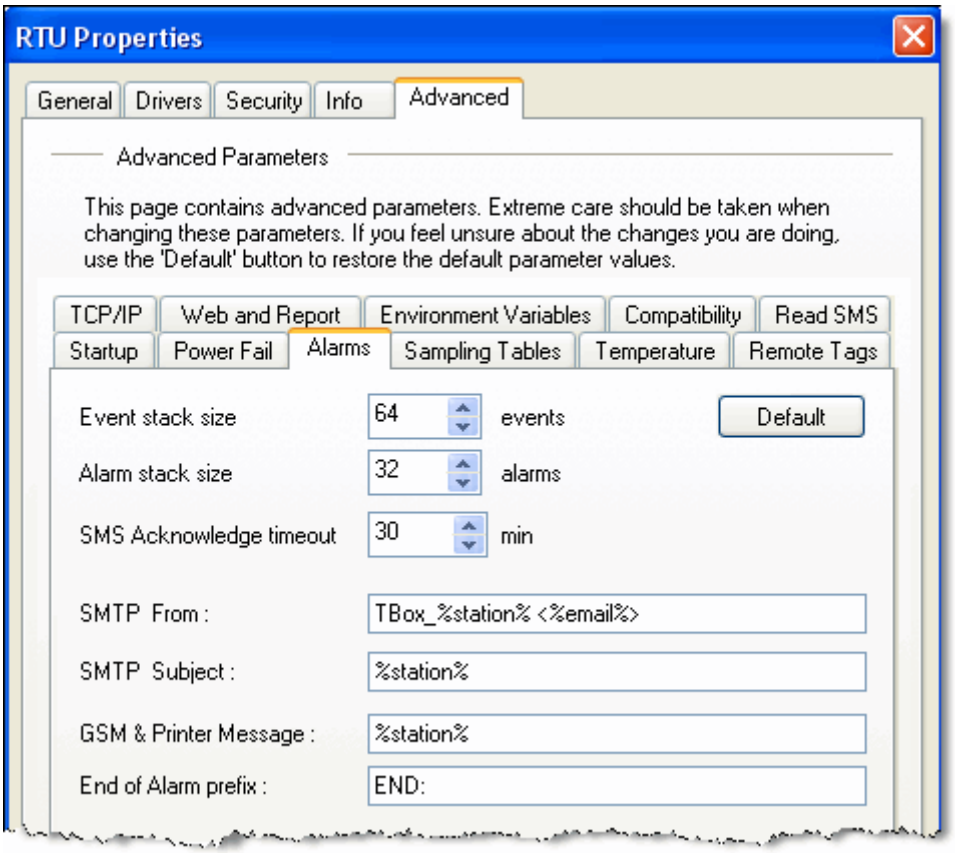
STOP

Reset All physical outputs at program stop: when this option is active, the RTU reinitializes the outputs to '0' at **stop**. This is particularly useful if you want to reset the outputs when sending a new program, and **you want to be sure they stay at '0'** during the sending and restarting sequence.
After that, outputs are monitored according to the process.

Disconnect ModBus address at program stop: all variables will have their ModBus address disconnected, which means that an external equipment accessing the RTU will receive communication error.
This feature has been implemented to allow a SCADA detecting immediately a TBox is stopped: as the ModBus addresses are not available, the RTU stays in communication but returns an 'Exception' error.

7.5.2. Alarms

The advanced parameters of alarms concern the **size of the stacks** and **customizing of e-mail and GSM message**.



Event stack: is a public stack, accessible by users, where alarms are available with date, time, recipient, message, status, ….

The Event stack can be displayed from the main menu: 'Communication' → 'Download' → 'Alarms'.

The **object 'Alarms' used in a WebForm** displays the Event stack. It corresponds also to the list of Alarms sent to *Tview* .

Alarm stack: is an internal stack used to buffer alarms when there are several to handle.

SMTP From: when receiving an e-mail from ***TBox ULP***, the field 'From' indicates the origin of the e-mail.

It accepts any text and the following parameters:

%station% : replaced by the name of the station (see General properties)

%email% : replaced by the e-mail address of the RTU

Example: TBox_%station% <%email%>

SMTP subject: when receiving an e-mail from ***TBox ULP***, the field 'Subject' can be dynamized like following:

When **sending a message**, the field 'Subject' contains the message or the title of the report (see Report Studio).

It accepts any text and the following parameters:

%station% : replaced by the name of the station (see General properties)
%email% : replaced by the e-mail address of the RTU
%time% : the time of the RTU when the e-mail was generated

Example: Report TBox %station% - %time% :

When **sending a report**, the subject field contains the Title of the report (see Report Studio); title that can contain the parameter %station%

GSM & Printer message: when ***TBox ULP*** sends a SMS, you can add information to the message. This information is sent in front of the message.

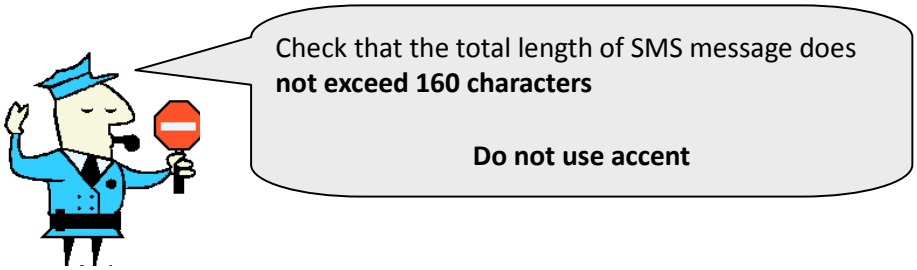
You can type any text and the following parameters:

%station% : replaced by the name of the station (see General properties)
%time% : the time of the RTU when the SMS (or printing) was generated
%condition% : It will result in an exclamation mark (!) in the message if the condition of the alarm is still active when the alarm is sent.

End of Alarm prefix : allows specifying a text that will be sent in front of the message, **when the alarm condition ends**, to indicate it corresponds to the End of the alarm.

Example: **END:**

Message sent when the condition ends:
END: Level too HIGH



Process alarm even when com. port not available:

An alarm corresponds always to a communication (at the exception of "Internal" alarms). When a alarm condition is activated, by default, it waits the availability of the com. port to be handled (GSM present, ...) This can lead to problems in handling escalation: if a media is not present, the alarm process will be stopped.
This option allows to carry on alarms, even when the port is not available.

Alarm filter on both transitions : this option allows computing the filter of alarm condition during **both transitions:** when the Tag value goes to alarm condition **AND** when it leaves alarm condition.
This option will be applied to **all alarm conditions**.
This is particularly useful to filter interferences on inputs.

Delay alarm processing when recipient's time table not available

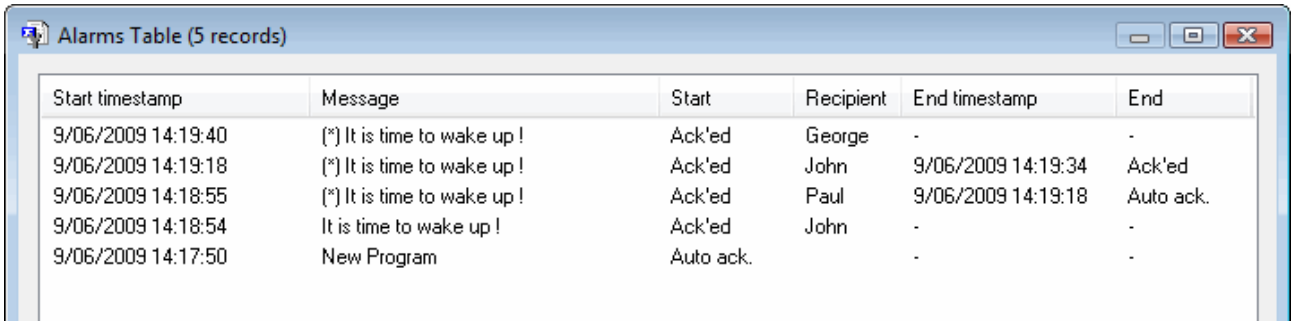
This feature is associated to the "Scheduling" attached to the recipient.
If the recipient is not in an active time table when the alarm is initiated, this feature provides 2 options:
- the alarm is auto-acknowledged (by default)
- the alarm is maintained in the alarms table until the time table becomes active. The "Start" timestamp is the one at the moment the alarm condition was generated.

Example: the alarm condition happens at 2:35 AM, but it is not an urgent alarm. It is an SMS meant to inform the technician. The "recipient" is configured with a time table starting at 8:00 AM (corresponding to the technician work shift). Therefore, the technician will receive the message at 8:00 AM, but with a timestamp of 2:35, informing him when the event happened

Display alarm calls in alarm table

This feature is associated to the alarm condition sent to a group of recipients.
When this feature is active, the alarms table displays the event having initiated the alarm and all the calls generated (see below).

Event stack displaying also alarm calls:
Working with group of recipients, it is also possible to display each call with its acknowledgment status:



Start timestamp	Message	Start	Recipient	End timestamp	End
9/06/2009 14:19:40	(*) It is time to wake up !	Ack'ed	George	-	-
9/06/2009 14:19:18	(*) It is time to wake up !	Ack'ed	John	9/06/2009 14:19:34	Ack'ed
9/06/2009 14:18:55	(*) It is time to wake up !	Ack'ed	Paul	9/06/2009 14:19:18	Auto ack.
9/06/2009 14:18:54	It is time to wake up !	Ack'ed	John	-	-
9/06/2009 14:17:50	New Program	Auto ack.		-	-

Message: message preceded by (*) means that it corresponds to a call
Start: always ack
Recipient: name of each recipient of the group
End timestamp: timestamp corresponding to the end of the call
End: acknowledgment status of the call: **Not Ack**; **Ack'ed** or **Auto ack**.

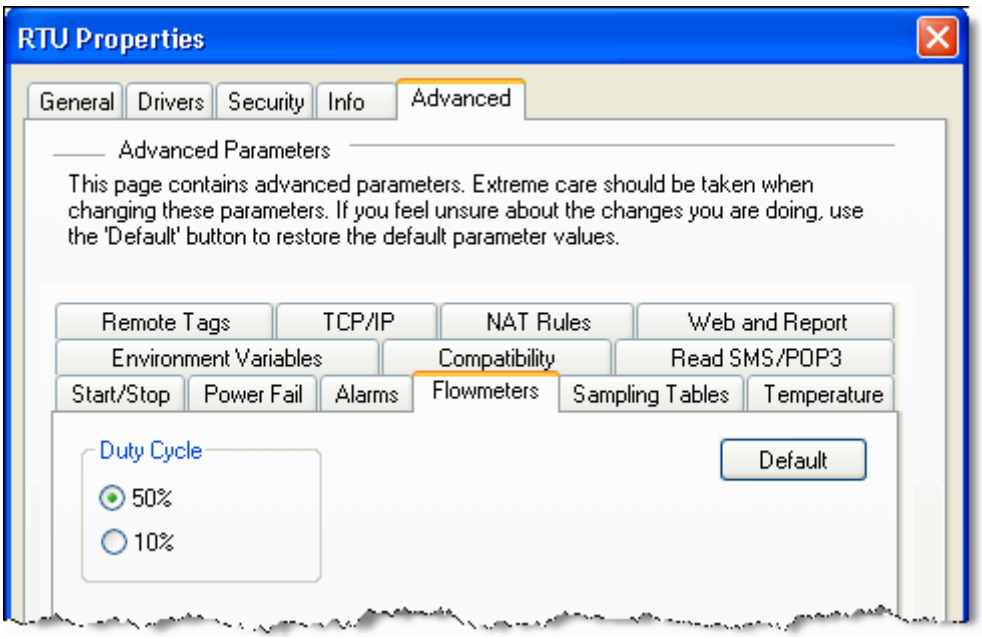
7.5.3. Flow Meters

Flowmeters with 'Pulse output' (potential-free contact) can be connected to ***TBox ULP***.

Even when ***TBox ULP*** runs in sleep mode, it reads the input at a maximum frequency showed in the table bellow. The flow, index, alarms, … are computed at wake-up.

The handling of the pulses depends on the duty cycle OPEN - CLOSE of the contact.
Two main categories of pulses are available:

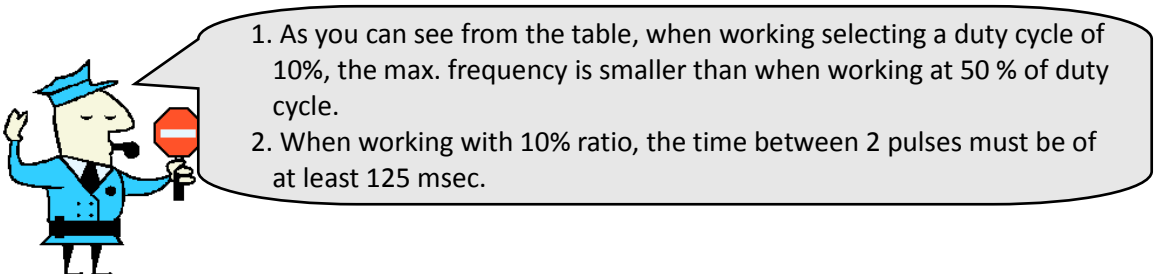
- Duty cycle of 50 % : the contact is OPEN 50% of the period and 50% CLOSE.
- Duty cycle of 10 % : the contact is OPEN 90% of the period and 10% CLOSE.



With **a wake up interval of max. 1 minute**, according to the selection, the supported timings are:

Setting: 50%	Min. pulse duration	Max. pulse frequency
pulse at 50 %	> 125 msec.	< 4 Hz
pulse at 10 %	> 125 msec.	< 0.8 Hz

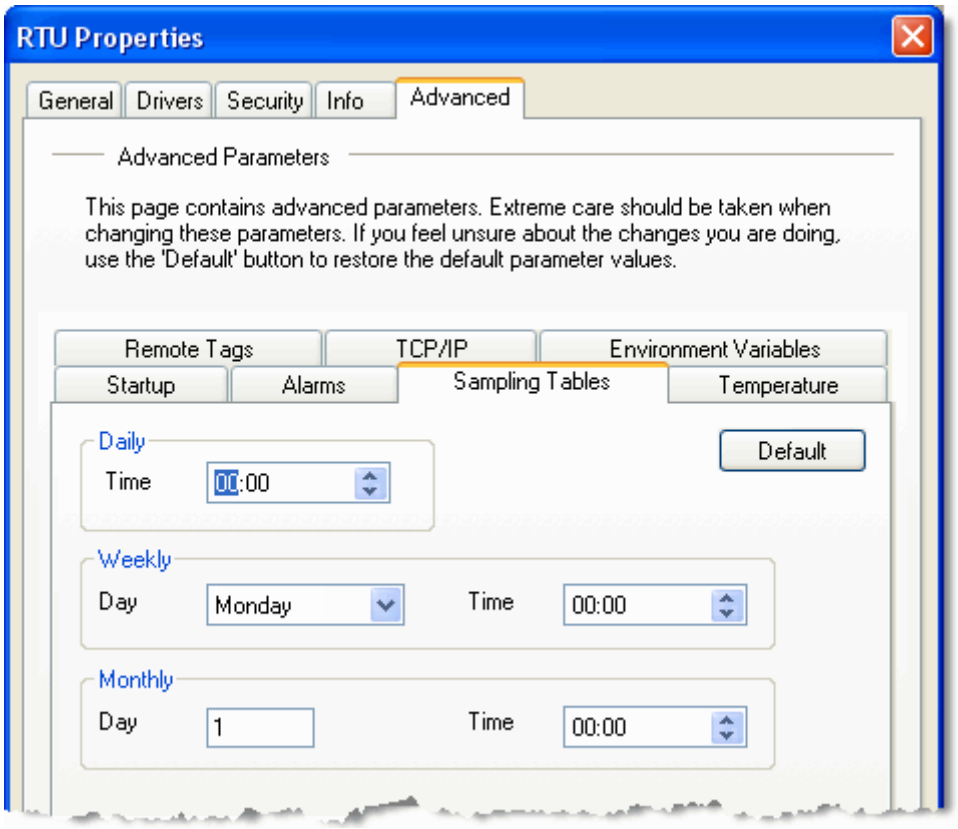
Setting: 10%	Min. pulse duration	Max. pulse frequency
pulse at 50 %	> 32 msec.	< 2.28 Hz
pulse at 10 %	> 32 msec.	< 3.2 Hz


1. As you can see from the table, when working selecting a duty cycle of 10%, the max. frequency is smaller than when working at 50 % of duty cycle.
2. When working with 10% ratio, the time between 2 pulses must be of at least 125 msec.

7.5.4. Sampling Tables

This menu gives access to the parameters for **long period recording in Sampling tables**. (See chapter 13.3: '***Sampling tables***')

Those configurations concern all sampling tables.



➢ Daily: When 'daily' is selected in sampling table, it is the time of the day the recording is executed.

➢ Weekly: When 'weekly' is selected in sampling table, it is the day of the week and the time the recording is executed.

➢ Monthly: When 'monthly' is selected in sampling table, it is the day of the month and the time the recording is executed.

7.5.5. Temperature

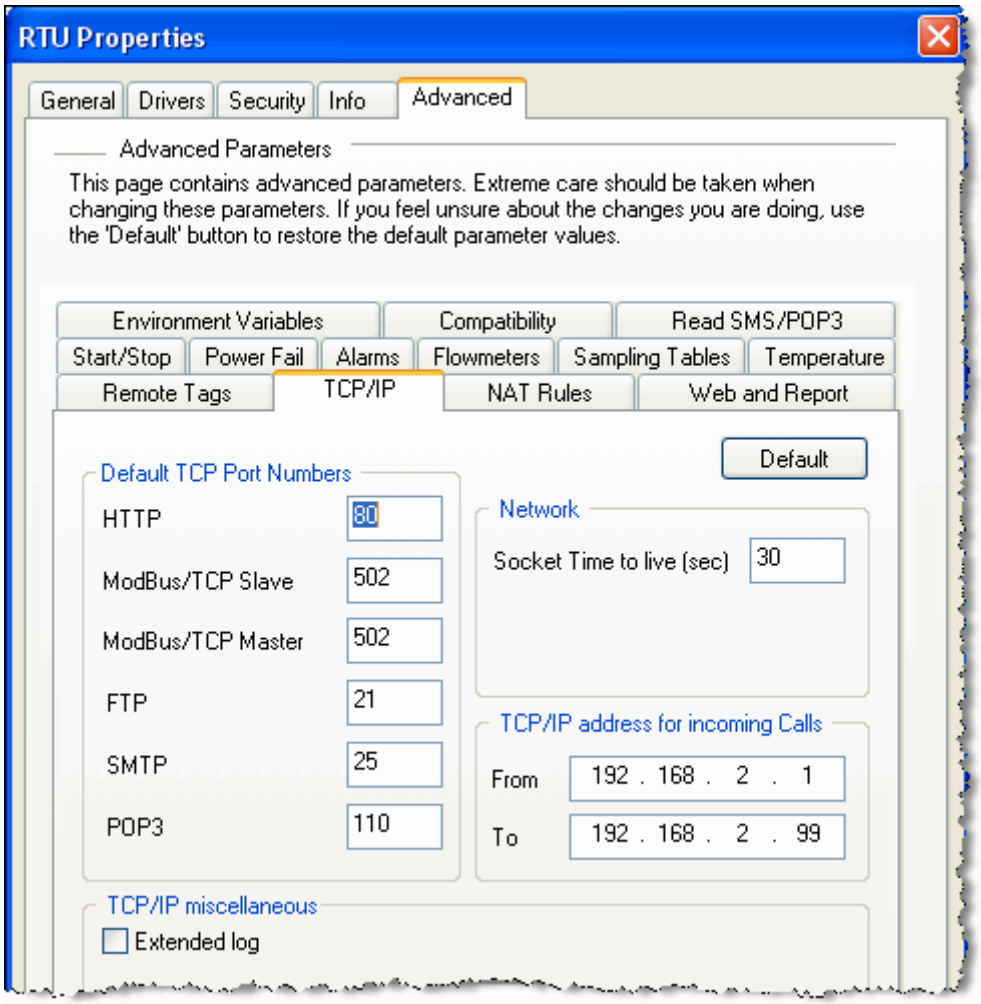
For internal temperature (Group 1 of I/O), you can define a unit: **Celsius**, **Fahrenheit** or **Kelvin**.

7.5.6. Remote Tags

Reset the device Trigger only if success When communicating as 'Master' using 'Remote Tags', a Trigger is associated to the device the RTU communicates with (see chapter 14. ***Remote Tags***).
This Trigger activates the communication according to a 'State' or 'Edge'. Working with Trigger 'Edge', the RTU restores automatically the Tag after the transaction(s).

- With this option active: the Trigger is restored **only when communication has been done successfully**.
- Without this option: the Trigger is restored when all Remote Tags associated to the device have been executed, with or without error.

7.5.7. TCP/IP



TCP Ports Numbers.

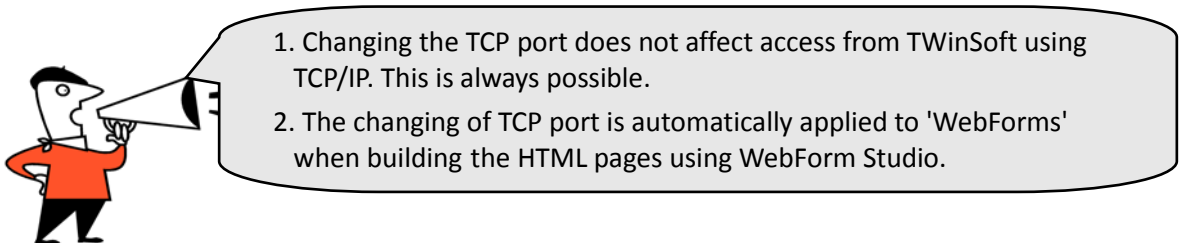
Each TCP/IP service has its own unique **TCP port**. It provides a logical location for the delivery of TCP data.

TCP Port number complies to a standard defined by the IANA to be sure everyone using a TCP service uses the same TCP ports according to protocols used.
When working with ***TBox ULP***, in some cases, you might want to change this port number.

HTTP: port used to access ***TBox ULP*** as WebServer.

ModBus/TCP-Slave: port used by a 'Master' to access ***TBox ULP*** as 'Slave'.

ModBus/TCP-Master: port used when ***TBox ULP*** is 'Master' to access a remote device.


1. Changing the TCP port does not affect access from TWinSoft using TCP/IP. This is always possible.
2. The changing of TCP port is automatically applied to 'WebForms' when building the HTML pages using WebForm Studio.

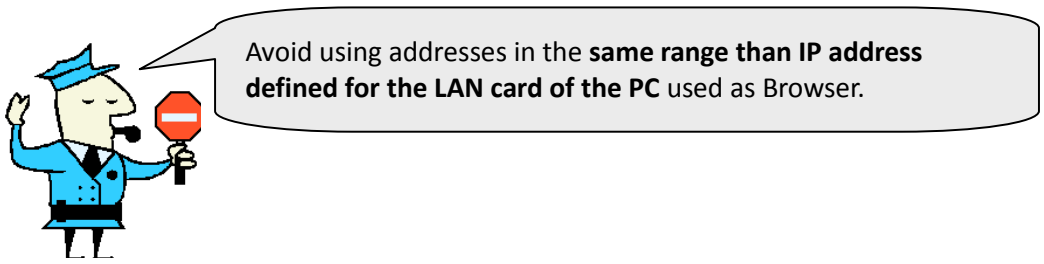
FTP: port used by ***TBox ULP*** to send Files (by default=21).

SMTP: port used by ***TBox ULP*** to send e-mails (by default=25).

TCP/IP addresses for incoming calls

Range of addresses used during incoming calls.
TBox ULP uses the first address of the range and applies the following to the **remote equipment**.

Typically, this information is needed when ***TBox ULP*** is used as a Web Server, dialled from Internet Explorer and TBox Dial It !.
The utility TBox Dial It ! , used to dial ***TBox ULP*** automatically, detects the IP address and uses it as URL.

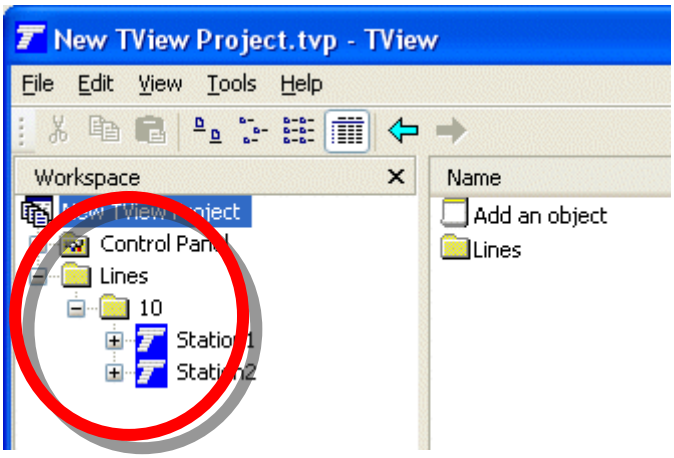


TCP/IP miscellaneous

Extended Log: ***TBox ULP*** provides a debugging mode to test TCP/IP connection (see chapter 10.7.)
The extended log adds any IP information sent/received by the CPU. It allows extended spying of the line.
Debugging uses Analog Chronology table. Check its size is sufficient (see chapter 7.1. ***General RTU properties***).

7.5.8. Environment variables

The environment variables are used when particular configuration might be needed in external software.
Available only when sending historical data through .tma file.

Variable	Value	Description
TViewPath	\path	The path in which the station will be created when importing data in TView. The path is the relative path from the Project workspace of TView. *Example:* with the Value: **\Lines\10** Result in TView : 
Longname	Type any long name	The name typed here will be used in TView, instead of the one declared in the 'General' properties, which is limited to 8 characters

7.5.9. Web and Report

Check user's WebFormViewer version: You activate the verification done by the WebForm Viewer.
When creating a WebForm, an indication of minimum version of the Viewer is declared in HTML pages sent in ***TBox ULP***. When going in connection with IE, WebForm Viewer will check the version of WebForm, and in case it is newer, display a message (see next).

Message: In case you have activated the option, you can specify a text that will be displayed in a message box.
This message box appears when connecting with IE to a WebForm that needs an update of WebForm Viewer to be displayed.
This information mainly depends on the type of connection used to access TBox:

- The TBox is accessed through a modem point to point connection: as it is impossible to access Internet from this connection, you type a message to inform on the procedure to access Internet and download the WebForm Viewer It can be from TBox manufacturer site (see below).
- The TBox is on Internet or part of a LAN: the message informs on the situation. By clicking 'OK', you jump to the URL (see next).

Download new version: This option can be checked to automatically download the last version of WebForm Viewer. It will be used in 2 cases:

- The TBox is connected to Internet:. then you have also direct access to Internet to download WebForm Viewer. You can leave the URL of the manufacturer:
http://www.tboxsupport.biz/free_downloads/DownloadWebFormViewer.html

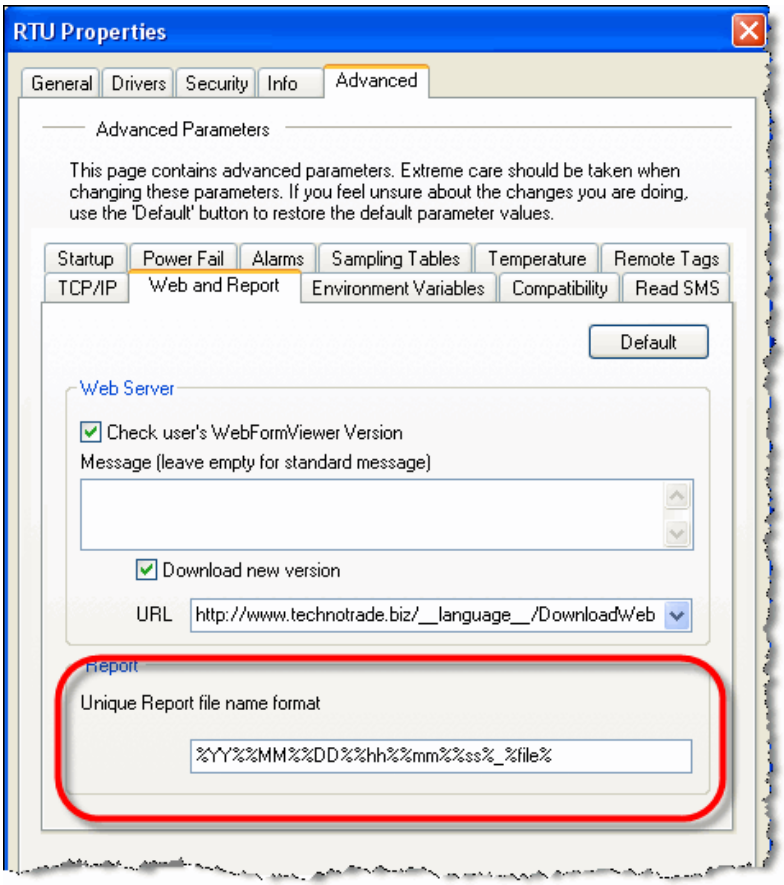
- The TBox is connected on a LAN: and one of the PC of the LAN contains the WebForm Viewer. You type the URL of the PC.
Example: \\PCServer\C\TBox\Download\DownloadWebFormView.htm

Unique Report file name format: When sending a report by FTP, you have the choice of sending the report with 'Unique file name' (see Report Studio → report properties → Advanced). In this case, the RTU includes supplementary parameters in head of the name of the report.

Accepted parameters are:

%station%: name of the RTU %email%: e-mail of the RTU
%time%: complete date & time
%condition%: ! (if alarm active)

%YY%: year in 2 digits
%YYYY%: year in 4 digits
%M%: month in 1 digit (if possible)
%MM%: month in 2 digits
%MONTH%: month in letters
%D%: day in 1 digit (if possible)
%DD%: day in 2 digits
%h%: Eur. hour in 1 digit (if possib.)
%hh%: Eur. hour in 2 digits
%H%: US hour in 1 digit (if possible)
%HH%: US hour in 2 digits
%mm%: minute in 2 digits
%ss%: second in 2 digits
%file%: name of the report
%ampm%: US time am/pm
~mytag~: value of Tag



Any supplementary text can be added.

8. Resources

The resources represent the list of the **hardware** that your ***TBox ULP*** has to its disposal.

The ***TBox ULP***, being an **all-in-one RTU**, has a fixed hardware all built within one card:

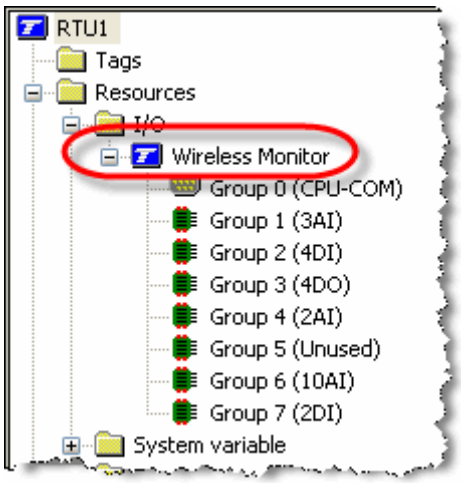
- A CPU
- Communication ports
- Several groups of I/O

- If the CPU needs to communicate in 'ModBus Master' to another device (CPU, or an external ModBus device), the latter must be declared as a Remote I/O card (see chapter 14: ***'Remote Tags'***)
- The Resources also contain 2 lists with System variables. Systems variables have pre-defined function (see chapter 8.8 ***'System variables'***)

8.1. The CPU card

When starting a new document, TWinSoft creates automatically the CPU card; the minimum for a ***TBox ULP*** project !

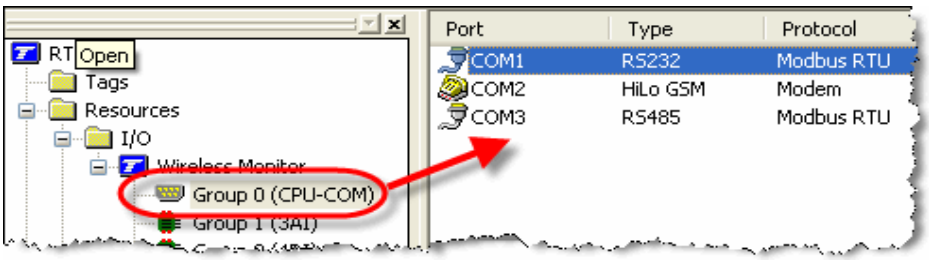
The communication ports of the CPU with their associated configuration and the I/O of the CPU are available from the 'Resources':



The CPU card is divided in several **groups**:

➢ **Group 0 :** communication ports
➢ **Group 1, 2, 3, … :** different groups of I/O corresponding (See chapter 17.9. for more details about I/O).

8.2. Communication ports



By selecting the **Group 0 (CPU-COM)** in the workspace, you can access each port separately.

8.2.1. Communication ports tabs

Depending on the type of communication port (RS232, modem or RS485), different tabs are available:

Parameters: general parameters (Baudrate, Protocol).

DCV: **D**igital **C**ommunication **V**ariables. Special variables with a pre-defined function (communication error, modem online, …). (see chapter 8.6)

ACV: **A**nalog **C**ommunication **V**ariables. Special variables with a pre-defined function (time-out, user ID, …). (see chapter 8.6)

Advanced: mainly 'timing' parameters required when CPU is 'Master' or 'Slave' in a ModBus communication.

TCP/IP: TCP IP configuration dedicated to the communication port, when available.

To enter the **configuration** of the communication port, double click the port in 'Group 0'.

8.3. Serial ports

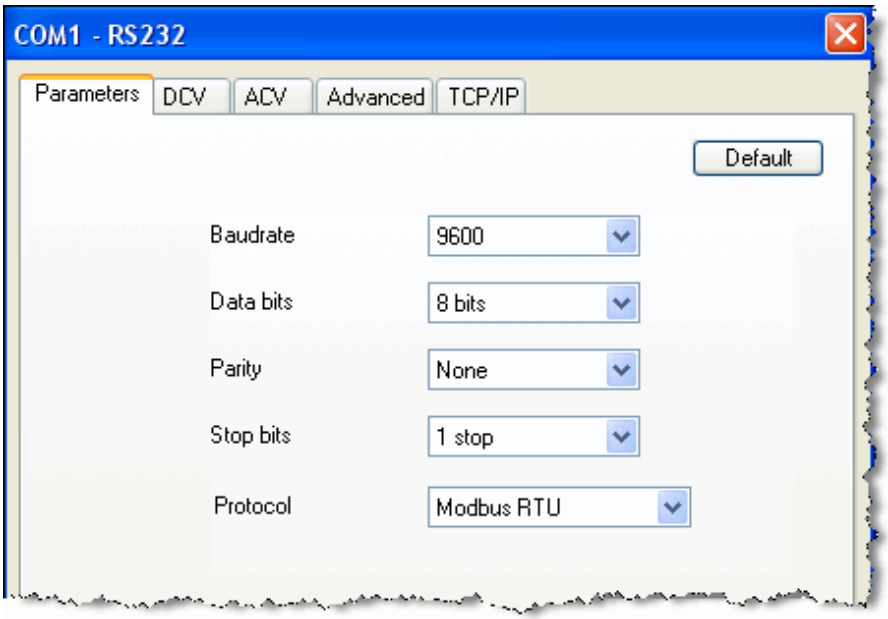
Baudrate: 200…115200 bps

Data bits: 7 or 8

Parity: None, Odd, Even, Space, Mark

Stop bits: 0, 1 or 2

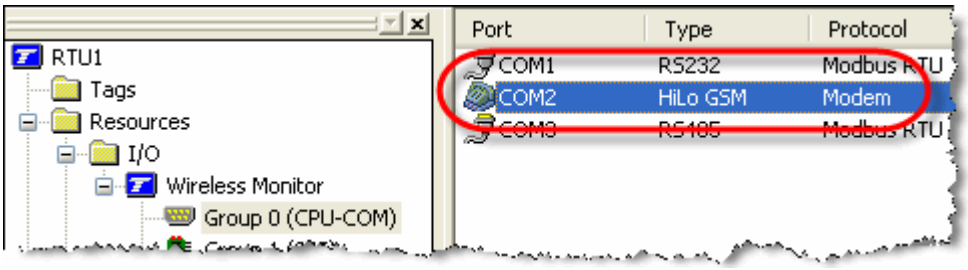
Protocol: ModBus (RTU/ASCII), Printer, NMEA



Example with COM1 – RS232

8.4. GSM/GPRS modem

When present, GSM modem is available as **COM2**.

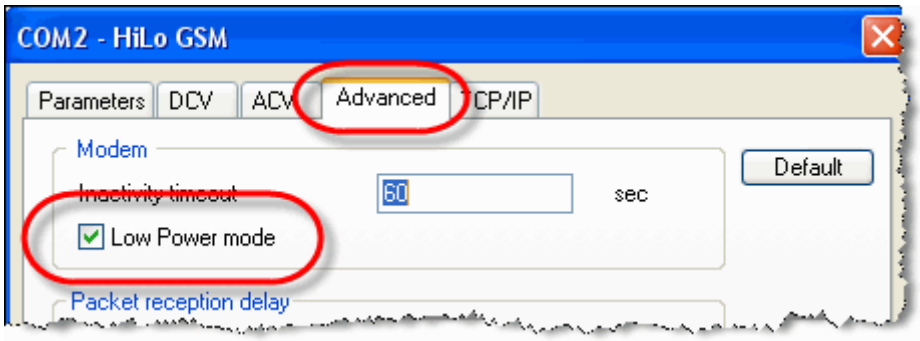


8.4.1. GSM in mode Low Power

Before entering GSM configuration, let's take a look at the consumption aspect of GSM.

It is important with ***TBox ULP*** to use the power the more efficiently. The hardware and software of ***TBox ULP*** is designed with this highest target.
On the same way, the GSM must be used to consume as less energy as possible.

It is therefore possible to configure the GSM in a 'Low Power mode'.



- <u>When the 'Low power' option is not checked:</u> the GSM is **powered permanently**; ready to be dialed-up and to dial out.

We consider real ultra low power operation when GSM is working at **Low Power mode**, with small periods of GSM wake-up and little communication.

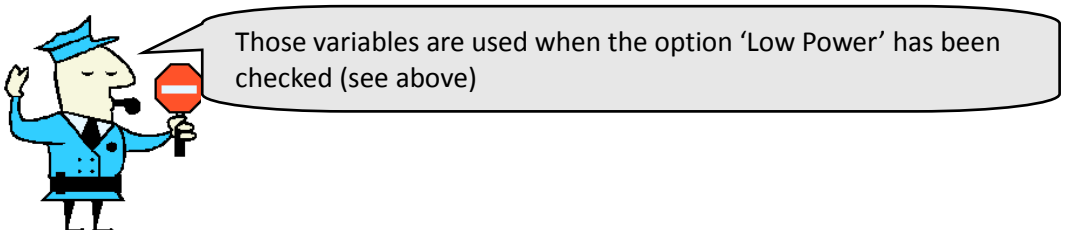
- <u>When the 'Low power' option is checked:</u> the GSM is powered according to 3 conditions:
- At wake-up, when there is an alarm defined with severity 'high'
- When the DCV 'COM2.ModemPower' = 1 (see example below)
- When the DCV 'COM2.ModemAlarm' = 1 (see example below)

Wake-up of GSM in case of Alarm of 'High' severity

In case an alarm of severity 'High' happens, at CPU wake-up, the GSM is powered, alarm is sent and the GSM returns to sleep mode. This is valid for GSM-DATA and GPRS communication.

Wake-up of GSM using Communication Variables

Three variables allow handling wake-up of the GSM, in order to save as much energy as possible.



Type	Name	Description
DCV	COM2.ModemPower	When ON, activate powering the GSM during the period defined in the Analog Communication Variable 'COM2.ModemPoT' (see next)
ACV	COM2.ModemPoT	Time in minutes while GSM is maintained powered when 'COM2.ModemPower' is ON. **After this period, even if still in communication, the GSM is switched off**.
DCV	COM2.ModemAlarm	Start powering the GSM to send alarm of severity 'Low' and 'Normal'. After sending alarms, the GSM switches off.

Examples of waking-up GSM using BASIC:

1. Wake-up of the GSM every Monday at 8:00 during 1/2 hour:

```
Com2_ModemPoT=30  ' Wake-up period of 30 minutes

If (weekday=1) and (hours=8) and (minute=0) and (Com2_ModemPwr=0) then
  Com2_ModemPwr=1
endif
```

Note: 'Com2_ModemPwr' is automatically reset by the OS after the number of minutes declared in 'Com2_ModemPoT'

2. Wake-up at 8:00 to send alarm of severity 'Low' and 'Normal':

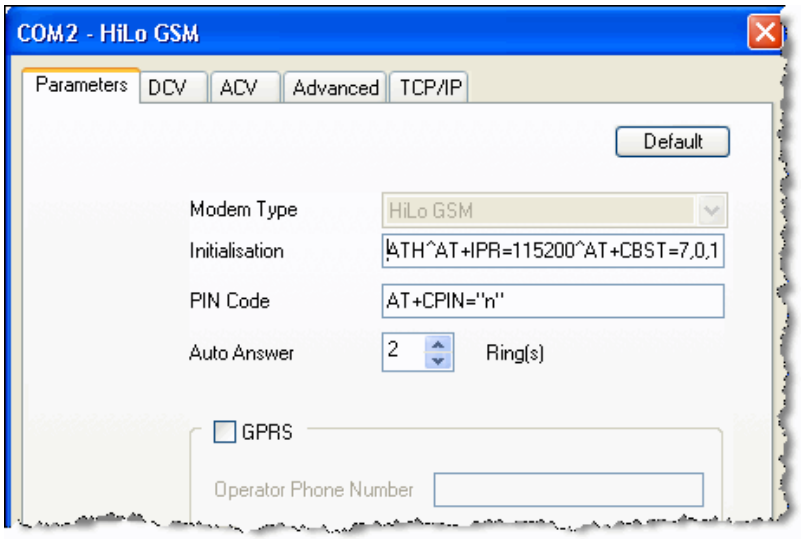
```
if (hours=8) and (Com2_ModemAla=0) then
  Com2_ModemAla=1
endif
```

Notes:

1. The two modes can be used at the same time. In those 2 examples when 'Com2_MademAla' is active at 8:00, at the same time as 'Com2_ModemPwr', ***TBox ULP*** will send alarms of severity 'Low' and 'Normal' and will stay awake during the time defined in 'Com2_PowerOn'.
2. 'Com2_ModemPwr' can be reset to stop power before the end of the period. If this happens during a communication, the power will be stopped at the end of the communication.

The GSM modem can be used in 2 modes:

- as a **GSM-data** modem
- in **GPRS** mode



In addition to standard modem configuration (initialization), some parameters are specific to GSM.

The main option 'GPRS' determine the working mode of the modem:

GSM-data **OR** GPRS

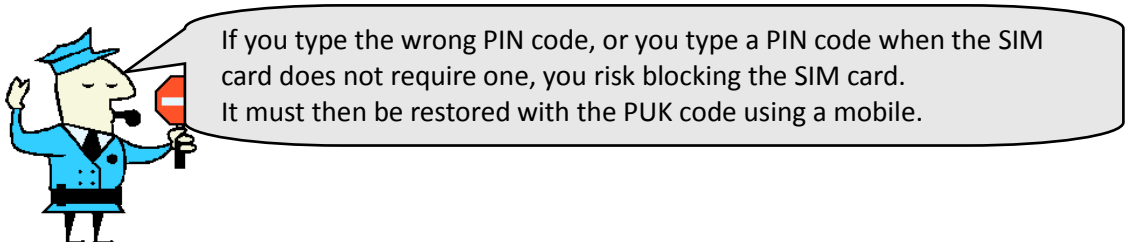
8.4.2. GSM-data settings

Initialization: should not be changed

PIN Code: If the SIM card you have inserted uses a PIN code, type it at the place of the letter **n**.

Example: with the PIN code 4896, you should have in the field: AT+CPIN="4896" **including the quotes**

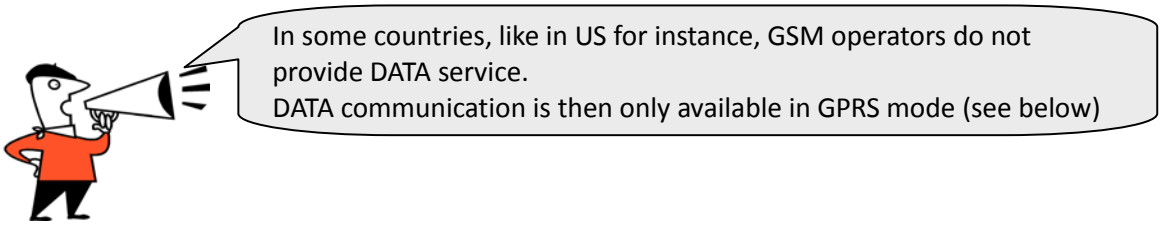
If the SIM card you have does not require a PIN code, you can leave the field as it is or erase it completely.


If you type the wrong PIN code, or you type a PIN code when the SIM card does not require one, you risk blocking the SIM card.
It must then be restored with the PUK code using a mobile.

Auto Answer: number of RINGS before the modem picks-up the line.

Dialing to a GSM-data

The SIM card of a GSM has three telephone numbers: VOICE (the one you dial to speak), DATA and FAX. To dial to ***TBox ULP***, you have to be sure that **data service is activated** and that you dial the **DATA number** (please call your GSM operator).


In some countries, like in US for instance, GSM operators do not provide DATA service.
DATA communication is then only available in GPRS mode (see below)

About sending e-mail or Files with GSM-data

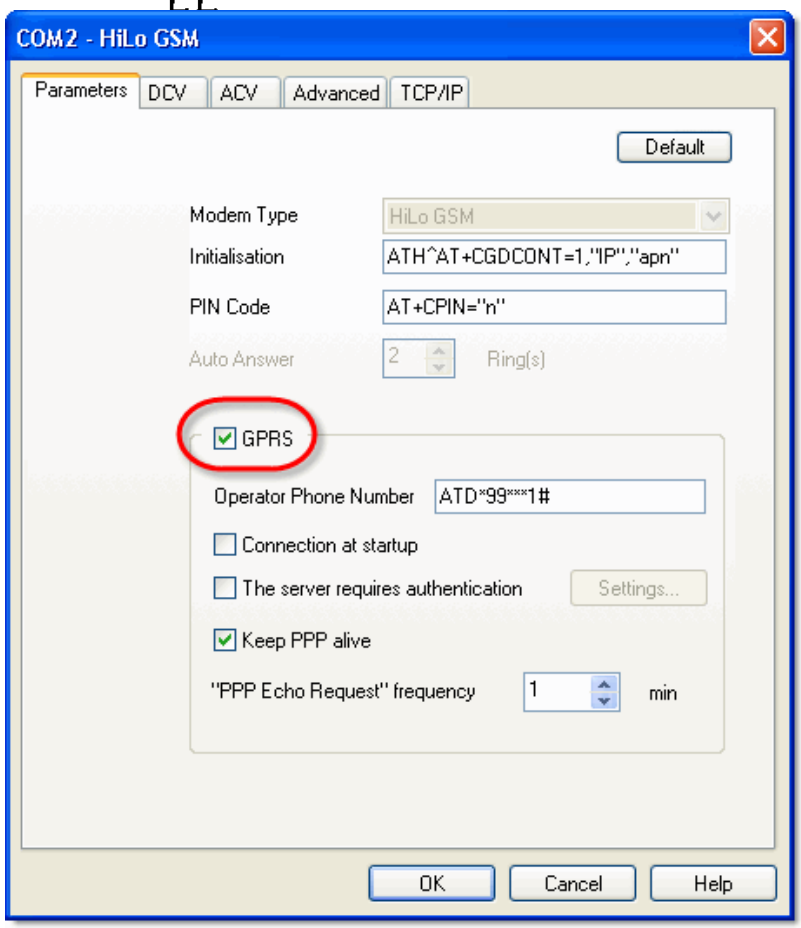
Some ISP requires **specific telephone number** for connecting through GSM (please check with your ISP).

In ultra low power mode, as all alarms, e-mail or FTP can be generated either using a alarm with severity “high” or with the communication variable Com2.ModemAlarm.

8.4.3. GPRS settings

When you run a ***TBox ULP*** with GSM and want to use GPRS, you have to activate the GPRS mode.

You have to choose either ‘GSM-Data’ mode **OR** ‘GPRS’ mode. It is not possible to use the modem in both modes at the same time, but it is possible to combine GPRS mode and sending of SMS (see below).



When selecting **GPRS**, TWinSoft automatically adapts Initialization and Operator Phone number fields (see next).

If the connection requires a **login**, select the option *‘The server requires authentication’*.

If you receive a **fixed IP address**, declare it in ‘TCP/IP’ tab.

Initialization: You have to update the initialization string with the APN (ask you GSM operator). Replace in the string the **apn** with the URL you receive from your GSM operator.

Example with Mobistar: AT+CGDCONT=1,“IP”,“WEB.PRO.BE”.

PIN Code: If the SIM card you have inserted uses a PIN code, type it at the place of the letter **n**.

Example: with the PIN code 4896, you should have in the field: AT+CPIN="4896", **including the double apostrophes**

If the SIM card you have does not require a PIN code, you can leave the field as it is or erase it completely.

Operator Phone number: special number to establish the GPRS connection.
Typically, the number is ***99***1#**. Check with your operator and type it following the command ATD.
Example with Mobistar, Proximus, SFR, AllIP, …: ATD*99***1#

Connection at start up: by default, this **option is not selected** (this is the proper way of working for an ultra low power RTU).
TBox ULP has to handle:
first **the modem wake-up**, using COM2.ModemPower and COM2.ModemPoT,
second **the connection** using the Communication Variables COM2.GPRSCon (see below).

When this **option is selected**, ***TBox ULP*** powers the modem to keep the connection **permanently**... which is not compatible with ultra low power.

Don't do it !

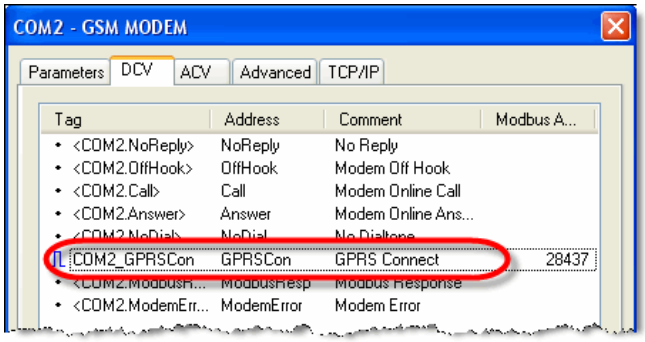
Examples of Activating GPRS connection using BASIC:

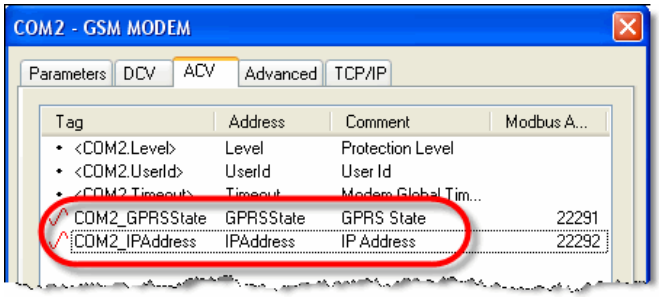
Wake-up of the GSM every Monday at 8:00 during 1/2 hour:

```
Com2_PowerPoT=30   ' Wake-up period of 30 minutes

If (weekday=1) and (hours=8) and (minute=0) and (Com2_ModemPwr=0) then
  Com2_ModemPwr=1
  Com2_GPRSCon=1
endif
```

Communication Variables dedicated to GPRS

Some communication variables allow monitoring GPRS and give information on the status.





Digital Communication Variable

COMx.GPRSCon	*	GPRS: Handles the GPRS connection. Working in manual connection, writing '1' forces a connection; writing '0' forces a disconnection. When working with automatic connection at start up, if you reset this variable the connection will stop, but after maximum 5 minutes, it will be automatically restarted. **Don't use this feature in ultra low power mode!**

Analog Communication Variable

COMx.GPRSState	-	GPRS: indicates the status of the GPRS connection. Value=0 : disconnected Value=1 : currently connecting Value=2 : connected Value=3 : currently disconnecting
COMx.IPAddress	-	GPRS: this register gives the IP address used by ***TBox ULP*** during its GPRS connection. The information is available in a DWORD, but in the list of Tags, you can display it as an IP address: from the list of Tags, right click the Tag → Display as → IP address. This information is very important **when working with dynamic IP address**. It can be sent for instance by e-mail (see Report Studio), or displayed in a webform, to inform on IP address changing. Accessing ***TBox ULP*** with dynamic IP can be done using **DynDNS**.

About sending alarms with GPRS

With GPRS, you are able to send e-mail or files using FTP. You create recipient(s) associated to the SMTP or FTP server you have associated to the GSM/GPRS.

In ultra low power mode, as all alarms, e-mail or FTP can be generated either using a alarm with severity "high" or with the communication variable Com2.ModemAlarm.

For sending e-mail, you may need to use a SMTP server specific to the GPRS connection. Ask your GSM operator.

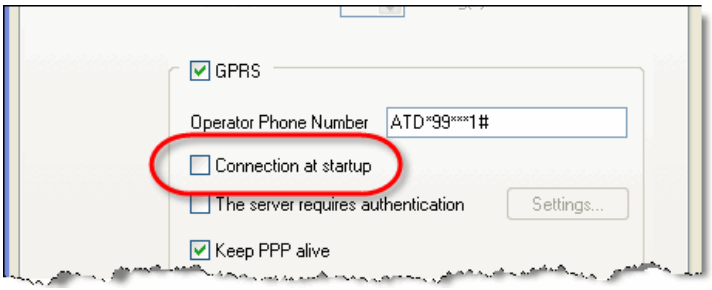
Example with Mobistar: **gprsmail.mobistar.be**

Sending of SMS with GSM configured in GPRS

It is possible, but only **when handling GPRS connection from the Ladder/BASIC**.

To use this feature, you have to monitor the GPRS connection manually:

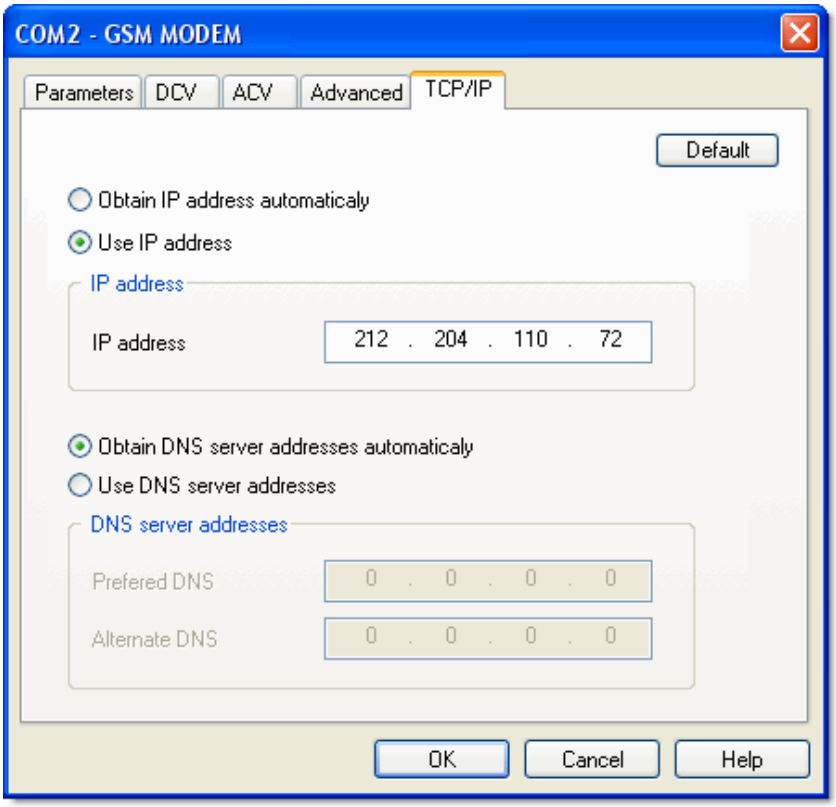
- Be sure the option '**Connection at startup**' is not activated.
- Make a Tag of the DCV '**GPRSconnect**'
- Change it to **1 to activate GPRS**
- Change it to **0 before sending SMS**



When GPRS is de-activated, it is also possible to receive SMS (See chapter 12: ***Read SMS Embedded***).

GPRS IP settings

GPRS represents a TCP/IP connection using GSM network. It then requires a TCP/IP configuration.



Obtain IP address automatically:
You work with dynamic IP address which is provided by the Operator at the connection.

Use IP address:
You work with fix IP address; it corresponds to the SIM card you use.

Obtain DNS server addresses auto.:
The Operator provides you with DNS.

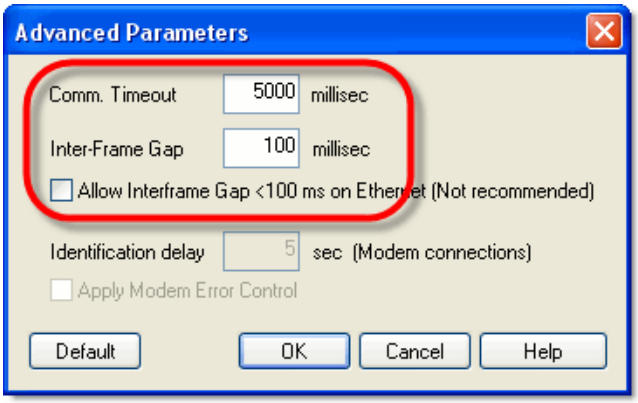
Use DNS Server addresses:
You want to use specific DNS addresses.

Using TWinSoft to communicate to an RTU in GPRS

To access ***TBox ULP*** through GPRS, GSM must be powered. Keep in mind the ultra low power concept and the monitoring of the GSM as explained 2.4.

Typically, TWinsoft will access ***TBox ULP*** from a LAN, using an Ethernet connection (if your LAN has a Gateway connection to Internet).

In order to have a reliable communication, you have to increase some timing parameters in TWinSoft: menu 'Communication' → 'PC Setup'; select 'Ethernet' and click 'Advanced'.



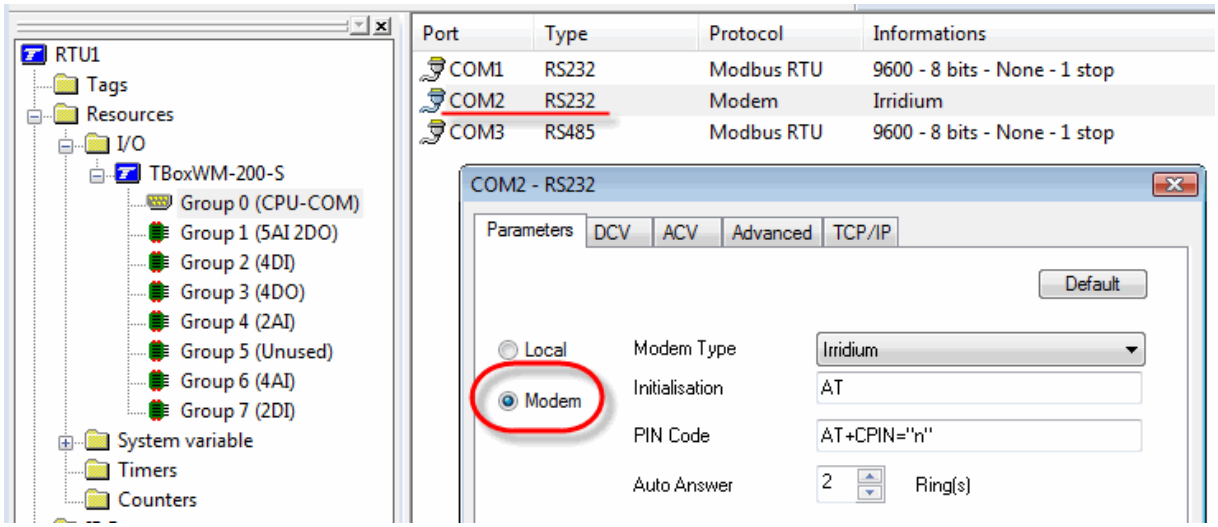
Change 'Comm. Timeout' to 5000 millisec. minimum

Change 'Inter-Frame Gap' to 100 millisec.

Before **sending a program through GPRS**, check the PC setup settings of TCP/IP, like explains chapter 5.3.2. ***IP address settings,*** point 3.

8.5. External Modem

TBox ULP-XXX-S models have a serial port instead of a internal modem.
This serial port can be used with an external modem.

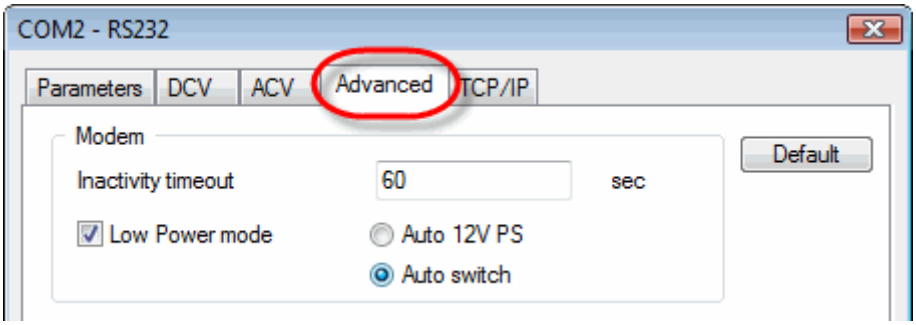


Power supply of this external modem must be controlled to avoid as much consumption as possible. This is achieved using the power connections available on the serial board (see details chapter 17.8)

8.5.1. Low power operation of external modem (WM100, WM200, LP400)

There are two ways of controlling the power, an automatic way and a manual way using system and communication variables.

Automatic way:

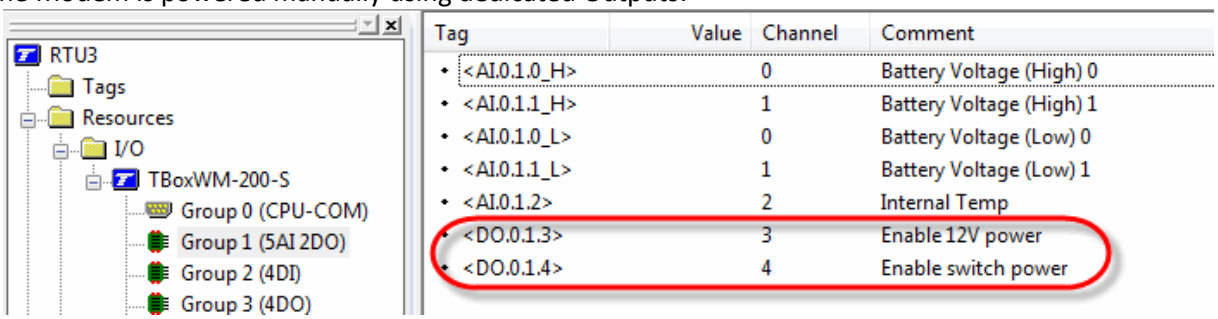


In the advanced parameters of the RS232 port, you select “Low Power Mode”. The modem can be powered either by internal 12 VDC (limited to 350mA) or if higher power is required by switching an external power supply (see details chapter 17.9).
DO NOT TAG the variables associated to the outputs (see next)

In this condition, the power of the modem will be automatically driven by the RTU, like it is for the internal GSM/GPRS: power cycled on demand with “Com2.ModemPower”, “Com2.ModemAlarm” or when alarm with severity high.

Manual way:

The Modem is powered manually using dedicated Outputs:



One output drives the internal 12 VDC.
One output drives the switch to external power supply.

Tag ONLY THE ONE you need.

Each time you want to communicate, you will have to switch on/off the variable used to power the modem, in addition to “Com2.ModemPower” or “Com2.ModemAlarm”.

8.5.2. Low power operation of external modem (LP450)

The major difference between LP450 and the others is that LP450 runs directly from 12 VDC battery. Therefore, the optional serial board does not provide a 12 VDC.

To drive the external modem, use the same as described above, but exclusively using the output “Enable switch power”.

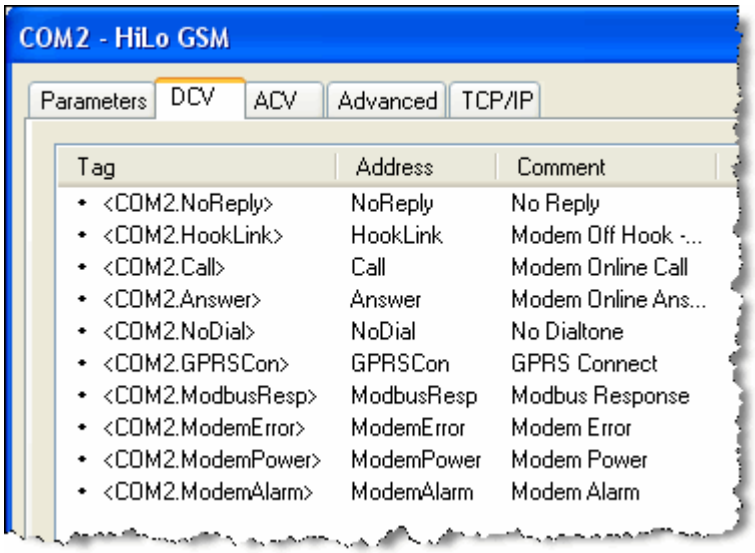
8.6. Communication Variables

Communication variables are dedicated registers to status of the communication.
It is very useful for controlling the connection and the access level authority.

Those variables are divided into 2 tabs, the Digital Communication Variables (DCV) and the Analog Communication Variable (ACV).

When you need one, you double click it from the list and declare it as a Tag. It becomes then available in any feature of ***TBox ULP***.

8.6.1. Digital Communication Variable



According to its function a communication variable is Read/Write or Read only.

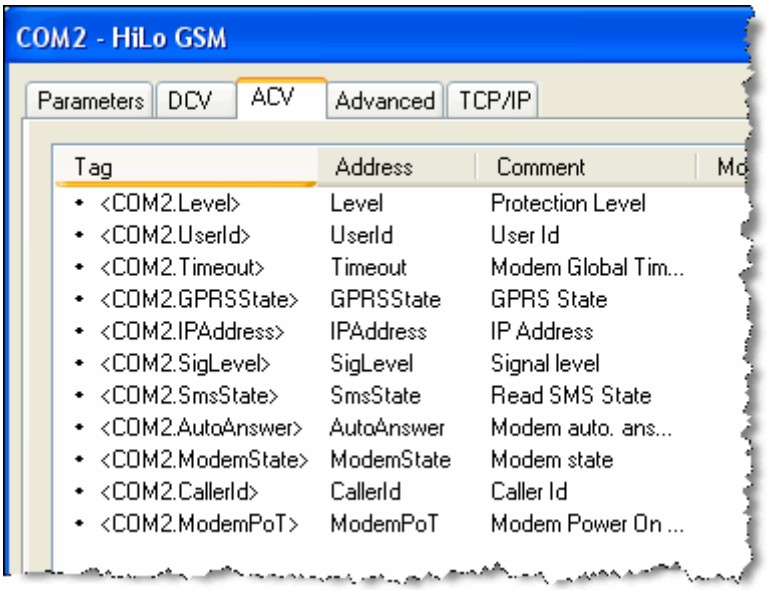
In the following table, the column **R/W** indicates:

- **-** : Read only.
- **0** : Write '0' only.
- **1** : Write '1' only.
- ***** : Write '0' or '1'.

Name	R/W	Description
COMx.NoReply	**0**	Communication: SET by ***TBox ULP*** in case of communication error. The possible errors are: - Timeout. - ModBus: Unknown address, wrong quantity, CRC error. - TCP/IP: wrong closing of socket. **Must be RESET by the user**.
COMx.HookLink	*	Modem: When at '1', indicates the modem has picked-up the line and it connecting to another modem. The success of the connection can be checked from the next 'Connect' variables. **Writing '0' or '1' forces the modem to hang-up. It is mandatory to use a positive or negative edge Trigger contact to a SET or RESET relay**
COMx.Call	-	Modem: Reading '1' indicates the modems are synchronized with ***TBox ULP*** 'Calling'
COMx.Answer	-	Modem: Reading '1' indicates the modems are synchronized with ***TBox ULP*** 'Answering'
COMx.NoDial	**0**	Modem: Reading '1' indicates that no dial tone has been detected when the modem has picked-up the line. **Must be RESET by the user**.
COMx.GPRSCon	*	GSM: Indicates the status of the GPRS. Writing '1' forces a connection; writing '0' forces a disconnection.

Name	R/W	Description
COMx.ModBusResp	0	Communication: indicates the port is transmitting. At each transmission, ***TBox ULP*** **SET** this register. To check ***TBox ULP*** is transmitting, **you RESET** this register and test whether it is SET again (using Ladder or BASIC logic).
COMx.ModemError	0	Communication: modem initialization failed. Modem has answered with an ERROR to one of the parameters of the init. String (see modem properties). A reason could be, working with GSM, because it is not registered yet. When **you RESET** this register, OS executes a warm start of the modem (sending init. string)
COMx.ModemPower	*	LowPower: When ON, start powering the GSM during the period defined in the Analog Communication Variable 'COM2.ModemPoT' (see Com2.ModemPoT in ACV). See example chapter 8.4.1.
COMx.ModemAlarm	*	LowPower: Start powering the GSM to send alarm of severity 'Low' and 'Normal'. After sending alarms, the GSM switches off

8.6.2. Analog Communication Variable



According to its function a Communication variable is Read/Write or Read only.

In the following table, the column **R/W** indicates:

- **-** : Read only.
- **0** : Write '0' only.
- **1** : Write '1' only.
- ***** : Write '0' or '1'.

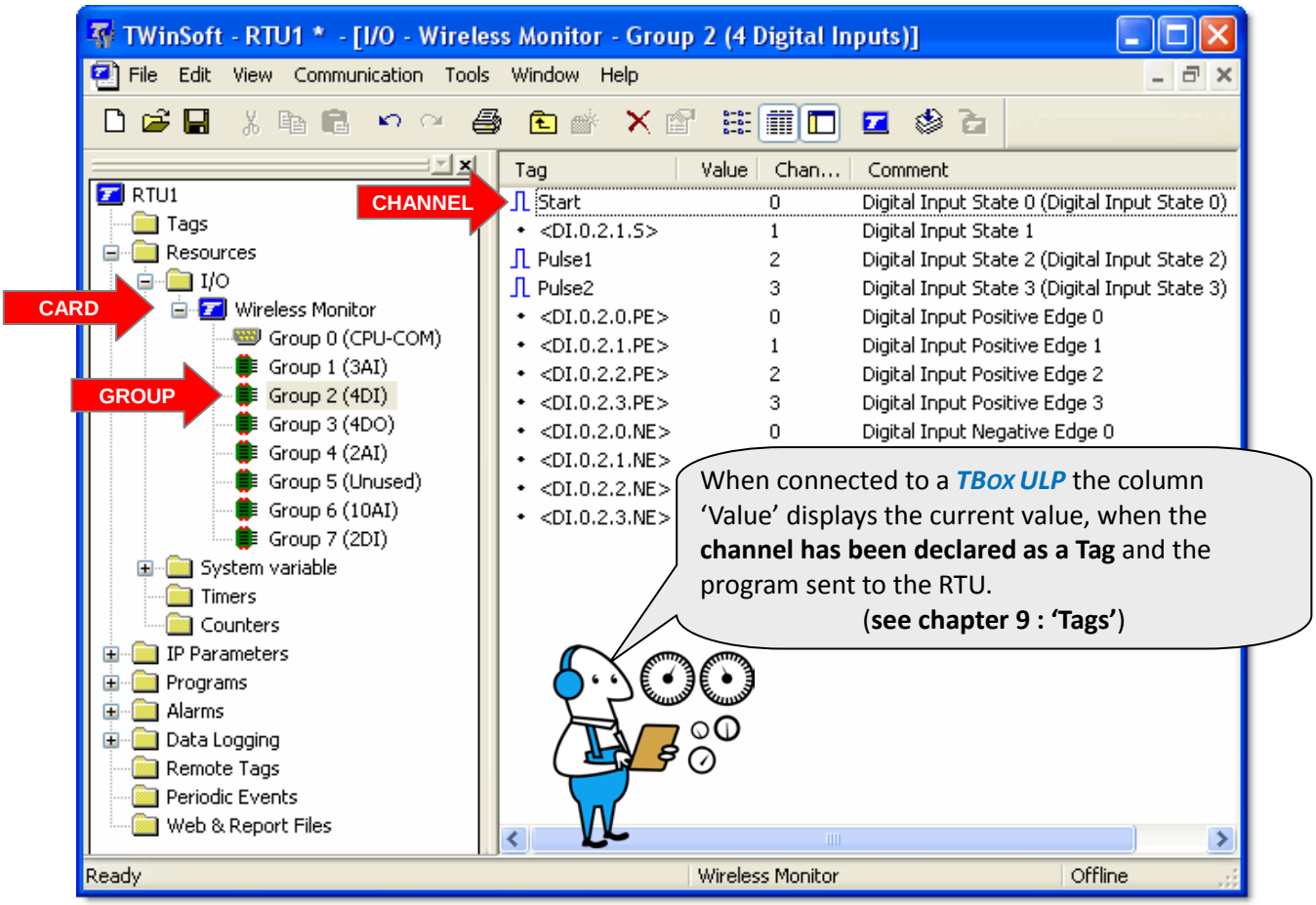
Name	R/W	Description
COMx.Level	*	Access Control: access level of the user currently logged (see chapter 16).
COMx.UserId	*	Access Control: user Id of the user currently logged (see chapter 16). The user Id and the authority level correspond to those you have defined with the utility ' PASSWORD '. The values returns to 0 when the user has disconnected. Values can be written to those registers. *Example:* when a user is connected you can modify its level access by writing a value in the register COMx.level (level available: 0, 1, 2 or 3). Those values can be stored in analog chronology for keeping a history on the access. When a user disconnects (Logout), the register returns to 0
COMx.Timeout	*	Modem: global time-out for hanging-up the modem when there is no communication. Correspond to the 'Inactivity time-out' in the 'Advanced properties' of the modem.

Name	R/W	Description
COMx.GPRSState	-	GPRS: indicates the status of the GPRS connection. Value=0 : disconnected Value=1 : currently connecting Value=2 : connected Value=3 : currently disconnecting
COMx.IPAddress	-	GPRS: this register gives the IP address used by ***TBox ULP*** during its GPRS connection. The information is available in a DWORD. To be interpreted, you should compute this Tag with mask to read the 4 bytes composing the IP address.
COMx.SigLevel	-	GSM: The quality of the GSM signal. The range of the value is 1 to 31. The value should be minimum 20 to be considered as an acceptable signal level. PSTN: Voltage on the line (+/- 20%)
COMx.SmsState	-	GSM: associated to the GSM, can be used to check the status of ReadSMS.
COMx.AutoAnswer	*	Modem: Read: indicates the number of RING before the off hook Write "0": no off hook Write "1": force off hook at the next RING
COMx.ModemState	-	MODEM: gives current status of the modem. Some possible values: 1: PIN code sent (GSM only when PIN code activated) 2: Wait after PIN code is sent 4: Init string accepted 7: Idle mode 9: Calling. Waiting CONNECT 10: RING arriving 11: Answering. Wait CONNECT ... The last value is maintained, until the next status changing.
COMx.CallerID	*	MODEM: variable which indicates the caller ID of the current incoming modem connection, 32 bits format, giving the 9 last digits of the calling number. It can be used in the program to trace and control who is calling Init string of GSM modem: Caller ID identification must be activated. Add at the end of the init string of **GSM**: ^AT+CLIP=1
COMx.ModemPoT	*	LowPower: Time in minutes while GSM is maintained powered when 'COM2.ModemPower' is ON. See example chapter 8.4.1. **After this period, even if still in communication, the GSM is switched off.** **Except when sending a program or OS, the GSM will be maintained powered until the end of sending and the restart of the GSM.**

8.7. Groups of I/O

The Hardware is represented in TWinSoft with a hierarchy of 3 levels:

- CARD: with ***TBox ULP***, it is **all-in-one CPU** card
- GROUP: the communication ports form a group (Group 0) as well as each type of I/O: **group of DI**, **group of DO**, **group of AI**, …
- CHANNEL: each **physical connection**, within a Group, corresponds to a channel.

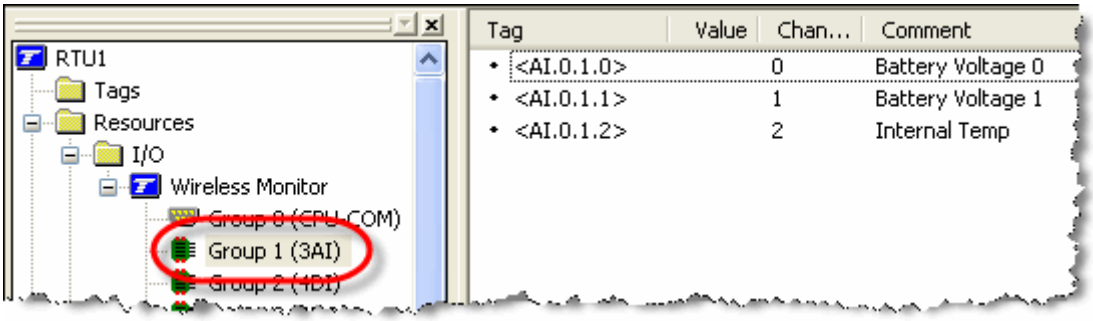

TWinSoft - RTU1 * - [I/O - Wireless Monitor - Group 2 (4 Digital Inputs)]
File Edit View Communication Tools Window Help
RTU1
Tags
Resources
I/O
Wireless Monitor
Group 0 (CPU-COM)
Group 1 (3AI)
Group 2 (4DI)
Group 3 (4DO)
Group 4 (2AI)
Group 5 (Unused)
Group 6 (10AI)
Group 7 (2DI)
System variable
Timers
Counters
IP Parameters
Programs
Alarms
Data Logging
Remote Tags
Periodic Events
Web & Report Files
CHANNEL
CARD
GROUP
Tag Value Chan... Comment
Start 0 Digital Input State 0 (Digital Input State 0)
<DI.0.2.1.S> 1 Digital Input State 1
Pulse1 2 Digital Input State 2 (Digital Input State 2)
Pulse2 3 Digital Input State 3 (Digital Input State 3)
<DI.0.2.0.PE> 0 Digital Input Positive Edge 0
<DI.0.2.1.PE> 1 Digital Input Positive Edge 1
<DI.0.2.2.PE> 2 Digital Input Positive Edge 2
<DI.0.2.3.PE> 3 Digital Input Positive Edge 3
<DI.0.2.0.NE> 0 Digital Input Negative Edge 0
<DI.0.2.1.NE>
<DI.0.2.2.NE>
<DI.0.2.3.NE>
When connected to a TBox ULP the column 'Value' displays the current value, when the channel has been declared as a Tag and the program sent to the RTU.
(see chapter 9 : 'Tags')
Ready
Wireless Monitor
Offline

See technical specifications of all I/O at the end of the manual.

8.7.1. Group1 – System Analog Inputs

From the 'Resources' and the list of I/O, open the 'Group 1 (3 AI)' to list internal I/Os.

The main board is equipped with internal analog inputs giving system data:

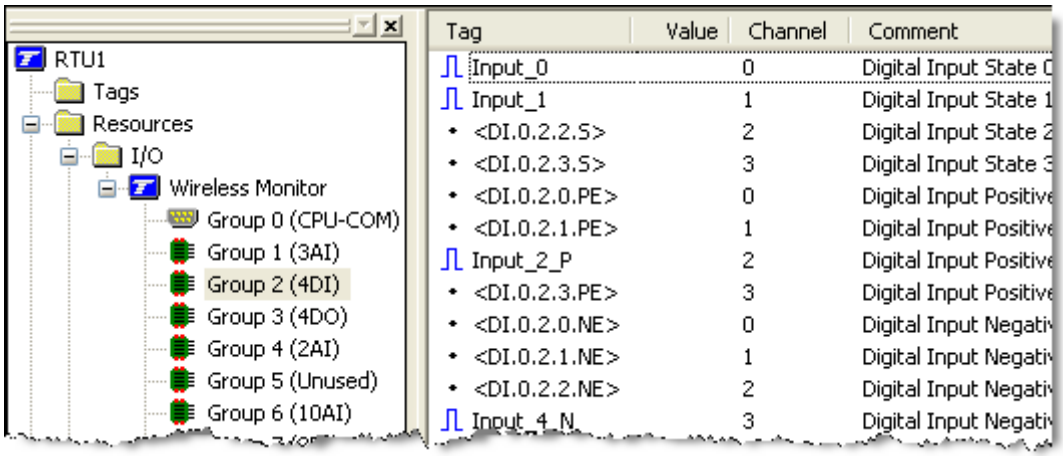


Variable	Format	Min	Max	Resolution
Battery 1 voltage	Float	0	3.6	0.1
Battery 2 voltage	Float	0	3.6	0.1
Internal temperature	Float	-50°C	+90°C	0.1

8.7.2. Group 2 - Digital Inputs

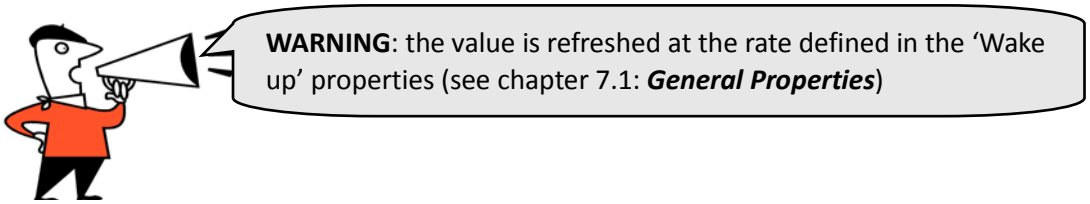
From the 'Resources' and the list of I/O, open the 'Group 2 (4DI)' to list variables associated to the digital input channels.

TBox ULP has 4 Digital Input Channels, scheduled to receive pulses. Associated to each channel, there are several variables.



Tag: The easiest way to declare the variable as a Tag: double click it, edit it and save it. The icon changes according to its type (digital or analog).

Value: The value is available only after the Tag has been declared and program sent to ***TBox ULP***.



Digital Input - State

It is the **direct digital input**. It is the image of the input contact at the moment of wake-up.

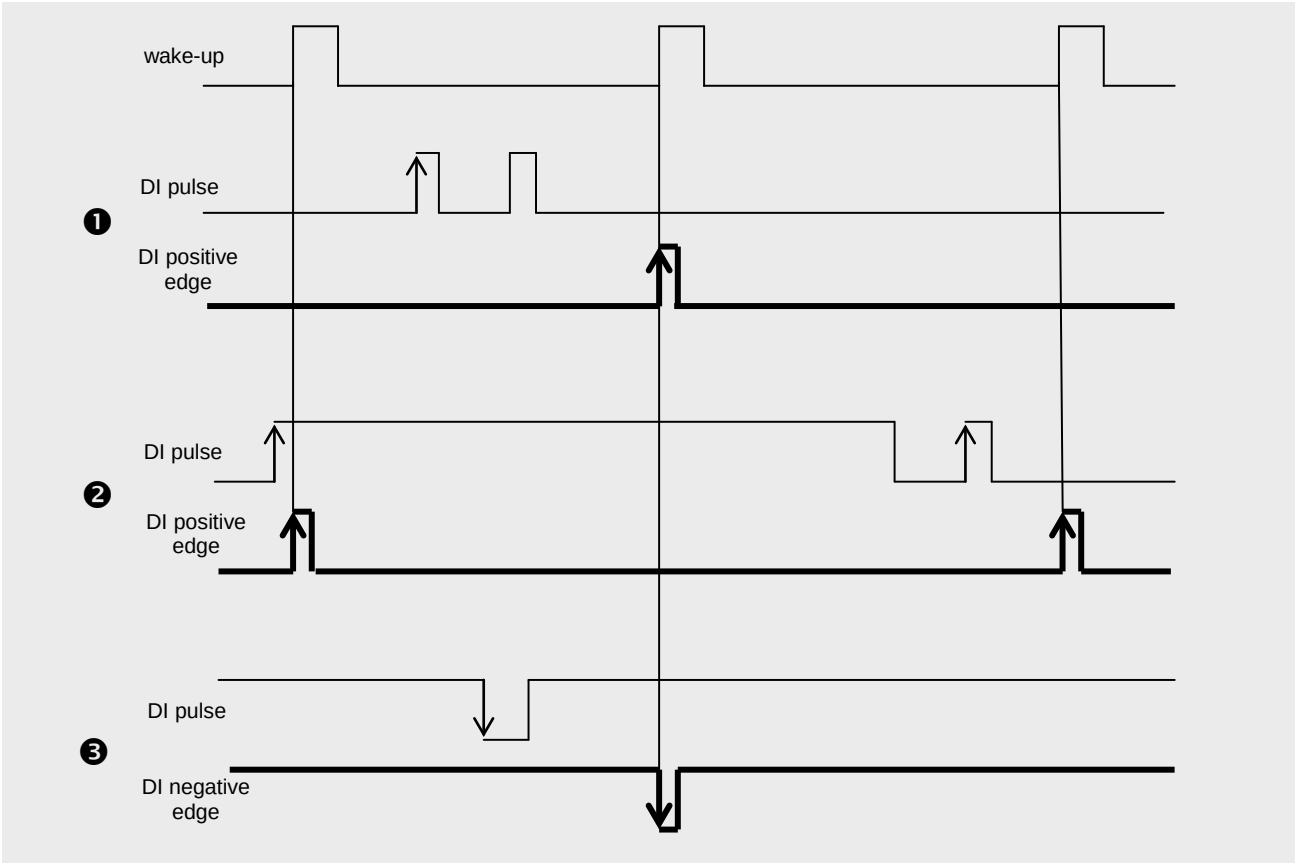
Independently of wake-up interval, the input is sampled 8 times per second. In order to detect changing between '0' and '1' states, the later must have a minimum period of 125 msec. each (maximum frequency of 4 Hz with a maximum wake-up interval of 1 minute).

Digital Input - positive edge

In case a **positive edge on the Digital Input** has occurred between 2 intervals of wake-up, it is memorized.
When ***TBox ULP*** wakes up, it changes the variable to '1' and treats it according to its use in the program (alarm, datalogging, remote Tags).
The variable is automatically reset after treatment (see example ❶ and ❷ here below).

Digital Input - negative edge

In case a **negative edge on the Digital Input** has occurred between 2 intervals of wake-up, it is memorized.
When ***TBox ULP*** wakes up, it changes the variable to '0' and treats it according to its use in the program (alarm, datalogging, remote Tags).
The variable is automatically Set after treatment (see example ❸ here below).



Digital Input - Interrupt

Digital Input 0 and 1 can act as interrupt on the microprocessor. This allows executing tasks without waiting for the next wake-up.
When an interrupt is detected, a cycle of Ladder/BASIC is executed.
Alarm conditions and chronology conditions will be tested after Ladder/BASIC has been carried on.

You will not see the value=1 of “Interrupt” before the wake-up. But the variable counter associated will be incremented. It can then be used in the Ladder/BASIC to indicate the interrupt has been detected.

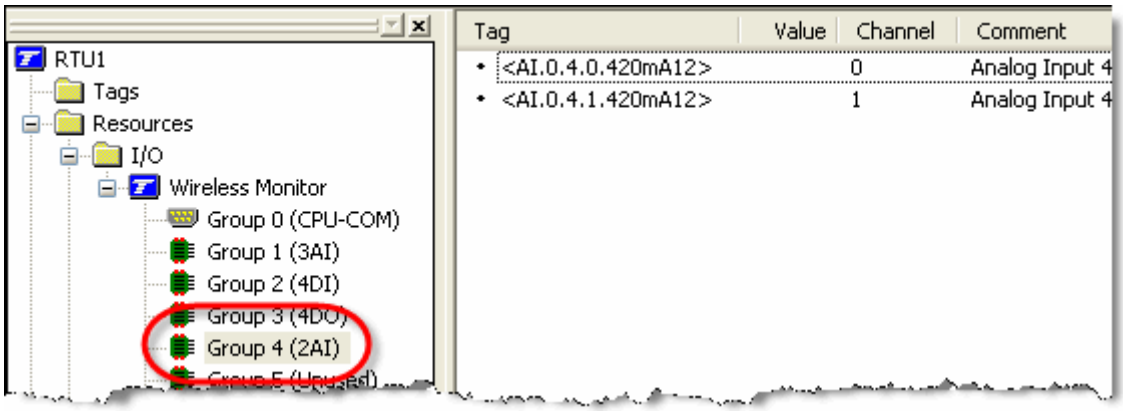
Using Interrupt variable has an impact on consumption, because the digital input stage must be powered permanently.

8.7.3. Group 3 - Digital Outputs

From the ‘Resources’ and the list of I/O, open the ‘Group 3 (4DO)’ to list digital outputs.

8.7.4. Group 4 - Analog Inputs

From the ‘Resources’ and the list of I/O, open the ‘Group 4 (2AI)’ to list analog inputs.



Tag: The easiest way to declare the variable as Tag: double click it, edit it and save it.
The icon changes according to its type (digital or analog).

Value: The value is available only after the Tag has been declared and program sent to ***TBox ULP***.

WARNING: the value is refreshed at the rate defined in the ‘Wake up’ properties (see chapter 7.1: ***General Properties***)

Voltage / Current Input

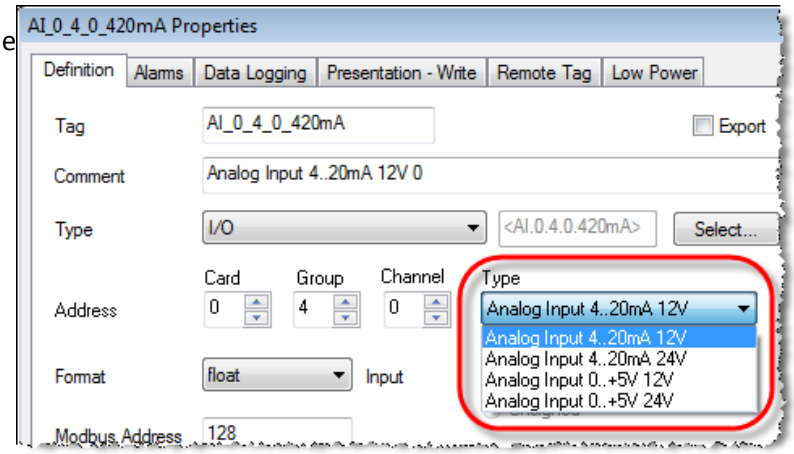
Each channel can be cabled to receive either 'Voltage' or 'Current'
(see chapter 17: ***Technical specifications & wiring***).

Tag definition parameters:
By double clicking the inputs, you enter into the 'Tag definition' menu:

For each analog inputs, you have the choice:

- voltage signal (0..5V)
- current signal (4..20mA)

As the sensor is powered by the input channel, 2 voltages are available:
- 12 V sensors
- 24 V sensors



Format: You select the format you want to display the pressure, between, **16bits** - Signed or Unsigned or **float**.

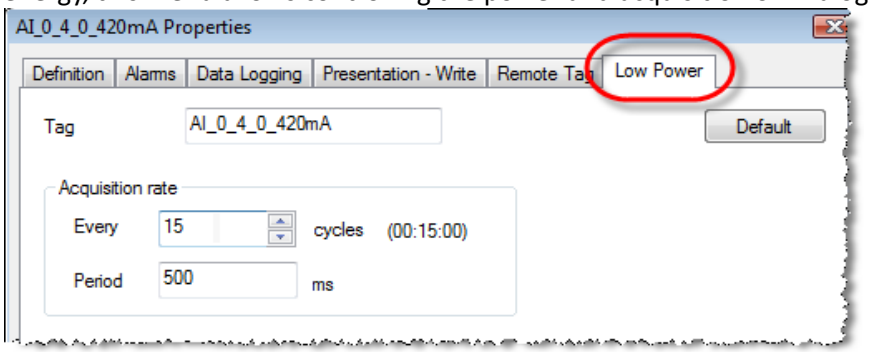
Scaling: A scaling can be configured to work with real values. The range depends on the format selected (see previous).
(default: minimum=0 and maximum=1000).

Type: You select in the list the sensor you use (see above).

Resolution: The resolution allows reducing the handling of the variable for small variation and therefore to consume less energy.
Example: with a resolution of '5', ***TBox ULP*** will only treat the variable when the value has changed from 5 units.

Acquisition rate configuration

In order to save energy, this menu allows controlling the power and acquisition of Analog Input:

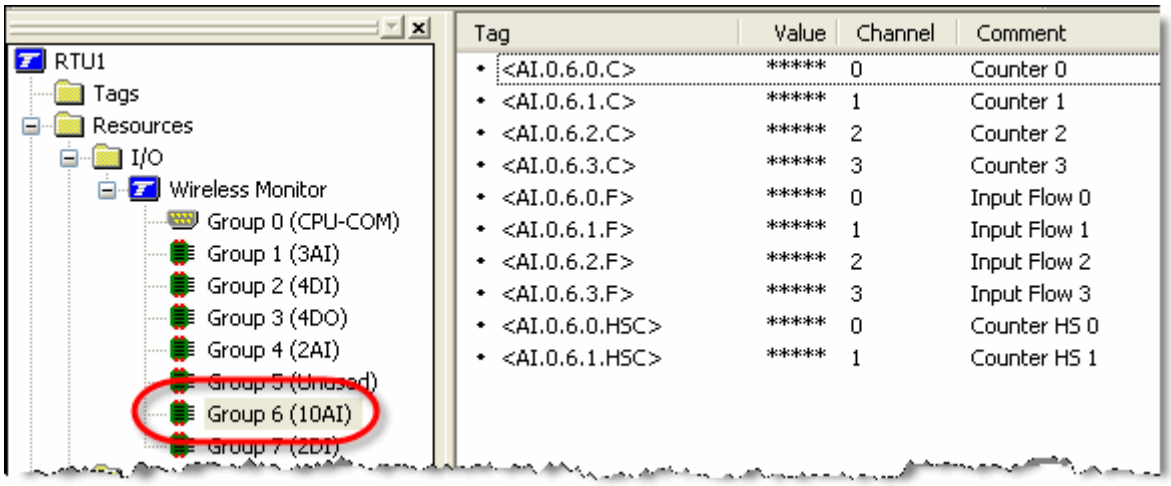


Frequency of Acquisition: you select a number of wake-up cycles between acquisition.
Example: with a wake-up rate of 1 minute, 15 cycles corresponds to an acquisition each 15 minutes.

"Setup time" period: the time needed for the sensor to stabilize. After this time, the value is read, and the process cycle is launched (Ladder/BASIC, datalogging, Alarms, ...)

8.7.5. Group6 – Analog Variables Associated to Digital Inputs

Some internal variables are associated to Digital Inputs, computing pulses to return calculated "*Counter*" and "*Flow*".



Counter (Totalizer)

Each Digital Input is associated to a 'Counter' variable. It accumulates the pulses of the digital input. It requires a **wake-up interval of max. 1 minute**.

Counters are saved when loading a new program or after a reset.

Counter can be synchronized to a mechanical counter (see Appendix F: ***Synchronization of counters***).

Tag definition parameters:
By double clicking the inputs, you enter into the 'Tag definition' menu:

Totalizer: you can define the number of digits you want to use. Above the maximum values, the counter turns over:

- 32 bits = max. 4294967295 (default).
- 4 digits = max. 9999
- 5 digits = max. 99999
- ….
- 9 digits = max. 999999999

Counter (HS)

Digital inputs 0 and 1 can be used for high speed counting (up to 10 kHz).

To use one of these counters, create the Tag "Counter HS" associated to the digital input.

Using HS counters increase the consumption, because the input stage needs to be powered permanently.

Flow

TBox ULP executes a calculation to interpret pulses of the Digital Input as a Flow.
It requires a **wake-up interval of max. 1 minute**.

A configuration is available to adjust the measurement according to the duty cycle of pulses (see chapter 7.5.3: ***Flowmeters***)

After starting, ***TBox ULP*** needs at least 3 pulses to start calculating the Flow. There are 2 mechanisms used in flow calculation, depending on the time between pulses:

- With at least 1 pulse every 12.5 sec.: the calculation is based on the quantity of pulses per period of time.
- With less than 1 pulse every 12.5 sec.: the calculation is based on the time between the last pulse and the previous one.

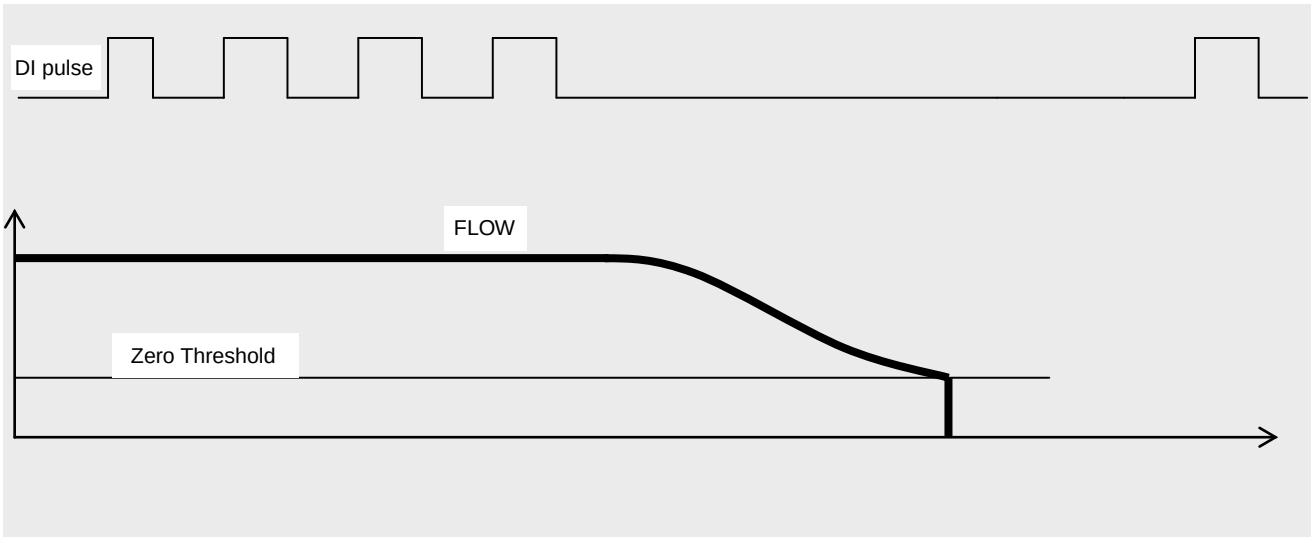
The precision is ± 1% of the reading value.

Tag definition parameters:
By double clicking the inputs, you enter into the 'Tag definition' menu:

Time unit: The unit in which you wish the calculation to be displayed.
Example: 'hour' for m3/h.

1 Pulse: The weight given to 1 pulse, according to the unit chosen above.
Example: '0.01' for 1 pulse=10 liters on a calculation based on m3.

Zero Threshold: Calculation is based on time between pulses. When ***TBox ULP*** does not receive pulses for a certain amount of time, it decreases the flow slowly.
When the value reaches the 'zero threshold', the flow is forced to ' 0 '



The precision of the Floating point register is applied to a range of 7 digits, starting with the highest number. (Precision = max 0.0001 %).
It corresponds to the norm **IEEE-754**
Examples:
12035652,56 the value handled by ***TBox ULP*** is 1203565xx,xx (x = any value).
120356,52656 the value handled by ***TBox ULP*** is 120356,5xxxx (x = any value).
120,35652656 the value handled by ***TBox ULP*** is 120,3565xxxx (x = any value).

8.7.6. Summary on the use of I/O

As we have seen above, each DI channel can be associated to several variables.
As we have seen above, it is possible to wake up ***TBox ULP*** using an “Interrupt” input.
Using the digital system variable [49] “PgmCnt” (see below), it is possible to execute several ,successive process cycles.

The table below illustrate how I/O and associated variables are handled:

Variable	Description	Handled at wake-up	Handled at each cycle
DI “State”	Current state at wake-up	**√**	**-**
DI “Edge”	State during sleep maintain	**√**	**-**
DI “Interrupt”	Launch one cycle	**√** (*)	**-**
DI “Counter”	Number of Puls on DI (-> 4 Hz)	**√**	**√**
DI “Counter HS”	Number of Puls on DI (-> 10 kHz)	**√**	**-**
DI “Flow”	Flow based on puls/period on DI	**√**	**-**
DO	Digital Output	**√**	**√**
AI	Analog Input (0..5 V or 4..20mA)	**√**	**-**

(*) Even if the DI “Interrupt” wakes up the ***TBox ULP*** , its digital value is only updated at the next wake-up

8.8. System variables

The system variables have pre-defined functions.
They are very useful to check or to act on features of ***TBox ULP***.

They are divided into 'Digital' and 'Analog'.

8.8.1. Digital System Variables

According to its function a register is Read/Write or Read only. In the following table, the column R/W indicates:

- **-** : Read only.
- **0** : Write '0' only.
- **1** : Write '1' only.
- ***** : Write '0' or '1'.

When the action **(SET)** is specified, it means that the ***TBox ULP*** maintains the variable at 1 to be sure it is detected. With such a variable, **you need then to reset it using BASIC or Ladder** logic.

Index	Name	R/W	Description
0	TikSec	**0**	Tik Second: Changes of state every second. Useful for counting time.
1	PrgRun	**-**	Program run: At each starting of ***TBox ULP*** , this register changes to 1 and stays at 1 as long as the BASIC/Ladder program runs. This register is used in BASIC/Ladder to execute operations only at the start of the program, with the help of a positive edge trigger function.
2	NewPro	**-**	New program: Start of a program flag. Changes to 1 if ***TBox ULP*** has started after having received a new program. Changes to 0 after a reset of the ***TBox ULP***.
3	Reboot	**1**	Reboot: complete restart of ***TBox ULP***. It is equivalent to hardware reset.
4	RstWat	**1**	Reset Watchdog: the watchdog checks the cycle time of BASIC/Ladder program. In case it is longer than 1 second, it resets ***TBox ULP***. This Watchdog can be reset to reinitialize the 1 second timer in case of cycle time longer.
5	Ala_On	**0**	Alarm on: this register indicates that alarm is active (not acknowledged). Writing 0 in this register causes a global acknowledgment of all alarms. It corresponds to a reset of the alarm stack.
6	Alaerr	**0**	Alarm in error: ***TBox ULP*** **SET** this register 1 when an alarm failed to be sent. This means that after the number of tries, the alarm has been auto-acknowledged. **Must be Reset by User**.
7	RstAla	**-**	Reset Alarm: Not used. See 'Ala_On' here above.
8	EnaDCr	*****	Digital Chronology: General enable of recording in digital chronology.
9	EnaACr	*****	Analog Chronology: General enable of recording in analog chronology.
10	EnaSam	*****	Sampling Tables: General enable of recording in sampling tables (not available).
11	EnaAla	*****	Enable Alarm: General enable of generating alarms.
12	DisCrd	*****	Flag digital chronology: can be associated to any digital chronology configuration to inhibit recording. When at value '1', inhibits recording in Database.
13	DisCra	*****	Flag analog chronology: can be associated to any analog chronology configuration to inhibit recording. When at value '1', inhibits recording in Database.
14	DisSam	**-**	Not used
15	DisAla	**-**	Flag sending alarm: can be associated to any Alarm condition. When at value '1', inhibits the sending of alarm.

Index	Name	R/W	Description
16	DaySav	-	Time: 1 = summer time (the ASPE ZoneBias = + 3600 seconds). 0 = wintertime.
17	PrgEnb	*	Program Enable: when reset to '0', allows stopping the execution of BASIC/Ladder program. It can be useful to execute the program manually (see next).
18	PrgOnc	1	Program Once: when set to '1', executes the cycle of BASIC/Ladder program once. Useful for debugging the program. ***TBox ULP*** resets the variable automatically.
19	TcpIpLog	*	TCP Logging: Setting this register activates the Debugging of TCP/IP connection. Very useful to trace problems when sending e-mail or FTP (see chapter 10.7). When this option has been activated, the information is available from TWinSoft main menu: 'Communication' → 'Download' → 'TCP/IP debugging'.
20	ALAovf	*	Alarm Overflow: overflow in the stack of alarms. The size of the stack of alarms can be adjusted from the 'Advanced' properties of the RTU
21	ComErr	0	Communication error: general communication error flag. It means that one of the communication ports (of the CPU or of a communication card) used as 'Master' has encountered a communication error. **(SET)**
22	SmtpEr	0	Smtp Error: an error occurred while sending an e-mail. **(SET)**
23	FtpErr	0	Ftp Error: an error occurred while sending files. **(SET)**
24	NTPErr	0	NTP Error: an error occurred while setting time of ***TBox ULP***. **(SET)**
25	GpsVF	-	GPS: GPS validity (connected on COM1). GPS returns a valid signal. Validity of the signal. When changes to '1', it indicates the GPS receives sufficient signals to calculate its position (from minimum 3 satellites). When changing from 0 to 1, the time of ***TBox ULP*** is set to the time of GPS, with correction in regards to GMT according to the location of TBox. If you want to update the time manually, you reset the variable
26	GPRSErr	0	GPRS Error: an error occurred during GPRS connection. ***TBox ULP*** does not succeed to connect (not supported yet) **(SET)**
27	ModemLog	*	ModemLog: authorizes the modem connection to be logged into chronology. The communication port is declared in the ASV.24 [PortIdLog]. **The ASV.25 [EventLog] must be tagged also.** The information is available in from the communication → Download → TraceLog (not supported yet)
28	SystemEr	0	SystemErr: the RTU detected an error during starting. Typically a problem with a card (not supported yet) or a discordance between cards detected in program and cards installed **(SET)**
29	MmcToRTU	-	MMC: indicates whether the program has been loaded from the MMC **1** = the program of the MMC is different from the one of the RTU and has been loaded from the MMC **0** = there is no MMC; the MMC is empty; the program of the MMC is identical to the one of the RTU (see also appendix C. ***Plug&Go***)
30	DigChrOv	-	Chronologies: Indicates that the amount of records in the digital chronology has reached the maximum selected
30	DigChrOv	-	Chronologies: Indicates that the amount of records in the digital chronology has reached the maximum selected
31	AnaChrOv	-	Chronologies: Indicates that the amount of records in the analog chronology has reached the maximum selected
32	RsDigChr	-	Chronologies: Allows emptying the digital chronology using a SET. Automatically reset by OS
33	RsAnaChr	-	Chronologies: Allows emptying the analog chronology using a SET. Automatically reset by OS

Index	Name	R/W	Description
34	BusError	-	System: indicates an error on the BUS. For ***TBox MS*** only
35	MasterAnsw	*	Remote Tag: when set to 1, allows handling of remote Tags on **incoming call**. It concerns then only **Remote Tags through modem**
36	DynDnsEr	**0**	TCPIP: error during a connection to DynDNS server. **(SET)**
37... 44	Tsl_Xa	-	Alarm: There are 8 time slices that can be used to build Time Tables. Those 8 variables indicate the activity of each of them
45	DisAla2	*	Alarm: inhibition flag #2 of the alarms. Used as inhibition flag in the 'Conditions' menu of the alarms. Let's you temporarily prevent from executing an alarm when at 1.
46	DisAla3	*	Alarm: inhibition flag #3 of the alarms. Used as inhibition flag in the 'Conditions' menu of the alarms. Let's you temporarily prevent from executing an alarm when at 1.
47	DisAla4	*	Alarm: inhibition flag #4 of the alarms. Used as inhibition flag in the 'Conditions' menu of the alarms. Let's you temporarily prevent from executing an alarm when at 1.
48	Pop3Err	*	Alarm: an error occurred while accessing POP3 server. **(SET)**
49	PgmCnt	**1**	Low Power: to carry on one more Ladder/BASIC cycle. The variable is reset by the OS. You set it anywhere in the program and a new cycle will be carried on (by default, ***TBox ULP*** runs the BASIC/Lader cycle once at each wakeup) See how I/O are controlled in chapter 8.7.6 above.
50	CntErr	**0**	Low Power: Counter synchronization (see Appendix F.) **1** = sync of a counter with a ID that does not exist. **(SET)**

8.8.2. Analog System Variables

According to its function a variable is Read/Write or Read only. In the following table, the column R/W indicates:

- **-** : Read only.
- ⑩ : Writable.

Index	Name	R/W	Description
0	Second	*	Time: Second in ***TBox ULP.***
1	Minute	*	Time: Minute in ***TBox ULP.***
2	Hours	*	Time: Hour in ***TBox ULP.***
3	Date	*	Time: Day of the month in ***TBox ULP.***
4	Month	*	Time: Month in ***TBox ULP.***
5	Year	*	Time: Year in four digit in ***TBox ULP.***
6	DayOfw	*	Time: Day of the week in ***TBox ULP.*** (Mo=1; Tu=2; We=3; …)
7	AlaCnt	*	Alarm quantity: Amount of alarms in the alarms stack. It means the quantity of alarms that have not been generated already. The size of the Alarm stack can be adjusted in the 'Advanced RTU properties').
8	AlaID	*	Alarm last index: Absolute index of the last alarms generated (number between 0 and 65535). Can be used **to acknowledge** an alarm by writing its index.
9	ALACur	*	Alarm current index: Absolute index of the alarm being currently handled (number between 0 and 65535).
10	ALARec	*	Alarm recipient: gives the index of the recipient of the current alarm. Can be used **to acknowledge** all alarms of a Recipient by writing its index (see index in the list of Recipients).
11	SamQty	*	Sampling Table: Quantity of sampling tables defined.
12	UtcTim	-	Time: Universal Coordinated Time (UTC). It is the number of seconds since 01/01/1970, GMT time. It is used as time-stamp reference for datalogging.
13	ZonBia	*	Time: Time difference in seconds with GMT.
14	ZonID	*	Time: ID of the zone where ***TBox ULP*** has been installed. It uses Regional Settings of PC, therefore **it is important that you configure the PC according to the location where *TBox ULP* is installed.**
15	WeYear	*	Time: week of the year **(*)**
16	CycTim	*	Time: time for one cycle of the program (BASIC and Ladder). This register is refreshed after each cycle. Within the program, you could compute this register to memorize the highest value.
17	AAcond	-	Alarms: Quantity of alarm conditions, which are still active.
18	LevId	-	Events: absolute number of the last event (0…65535).
19	AppVer	-	Application version: according to the 'version' indicated in the 'Info' of the RTU properties. This register returns a version in a WORD format: 0…65535
20	OsVer	-	Operating System version: running in ***TBox ULP***
21	OsBuil	-	Operating System build: build number of the OS running in ***TBox ULP***
22	LoaVer	-	Loader version: Loader version running in ***TBox ULP***
23	LoaBui	-	Loader build: build number of the loader running in ***TBox ULP***
24	PortIdLog	*	Selection of the port for TCP debugging (see chapter 10.7)
25	EventLog	-	Contains internal codes used for TCP debugging (see chapter 10.7)
26	MilliS	-	TIME: With CPU-16: 10 milliseconds tik With CPU-32: 1 millisecond tik (not available yet)

Index	Name	R/W	Description
27	GpsLat	-	GPS: current latitude given by the external GPS (ACC-GPS). Latitude in degrees multiplied by 1000000 (example: 50123456 means 50 degrees + 0.123456 degree). Resolution : 11 cm. Precision 15 meters
28	GpsLong	*	GPS: current longitude given by the external GPS (ACC-GPS). Longitude in degrees multiplied by 1000000 (example: 7123456 means 7 degrees + 0.123456 degree). Resolution : 11 cm. Precision 15 meters
29	GpsAlt	-	GPS: current altitude given by the external GPS (ACC-GPS). Altitude in meters. Resolution, 1 meter. Precision: depends on the quantity of satellites. Poor precision
30	GpsSats	-	GPS: quantity of satellites detected by the external GPS (ACC-GPS). Must be of minimum 3, or even 4 to expect a good precision.
31	Rerout	*	Modbus: variable 16 bits, each representing a COM Port from 1 to 16. The bits corresponding to the Ports in ReRouting are at 1, the other at 0. Can be use to set the mask.
32	MasterErr	*	Communication: indicates the last station ID (modbus address) in communication error. Once an error has been detected, the value is maintained until next error. Usually, communication errors can be solved by modifying the time-out available in the 'Advanced' tab of the communication used (End of Fame Detection, IFG, Rx Time-out). To trace an error, we advise you to reset the variable and check it when it is different from 0. When this happens, you can handle it in your process and reset the variable, that it is ready for the next error
33	CardErr	*	System: this variable indicates card(s) in error. For ***TBox MS*** only
34	CPUusage	-	Low Power: gives the number of seconds the CPU has run in high frequency (=with high consumption). It includes wake-up procedure, I/O scanning, process, alarm and datalogging handling, remote Tags communication, ... and the return to sleep mode procedure.
35	SerialNb	-	Hardware: indicates the serial number of the CPU (see sticker on the side of the card).
36	CPUmode	-	Redundancy: for ***TBox MS32*** only
37	OpenSoc		TCP/IP: number of sockets opened. The socket availability is: - 1 socket reserved for Remote Tags 'Client' - 2 sockets reserved for 'Alarms (FTP needs 2 sockets) - 5 sockets available for 'Server' connection
38	GpsSpeed	-	GPS: with a GPS on TBox, current speed of TBox, expressed in km/h
39	GpsRoute	-	GPS: with a GPS on TBox, current direction of TBox, expressed in degree (0 .. 359.9 degree)
40	AlaPop3	-	Alarm: it indicates the number of alarm needing to be acknowledged by POP3 connection
41	EvenCur	*	Alarm: it indicates the current Event ID
42	HardRev	-	HW: it indicates the hardware revision of the CPU
43	Pop3State	*	Alarm: indicates the state of POP3 connection. Particularly useful when monitoring the RTU with POP3 connections. The last value is maintained: 1 Accepted message received 2 Acknowledgment received 10 Invalid message 11 Unknown command 20 Incorrect password 21 Incorrect password or not supplied for a com. Port protected 30 Message received does not match a pre-defined message

Index	Name	R/W	Description
44	CntID	*	Low Power: Variable containing the ID of the Counter. It is used when doing a counter synchronization (see Appendix F.)
45	CntValue	*	Low Power: Value of the counter when it was pressed on TEST button. It is used when doing a counter synchronization (see Appendix F.)
46	CntTime	*	Low Power: UTC time when it was pressed on TEST button. It is used when doing a counter synchronization (see Appendix F.)
47	CrdIndex		Datalogging: current position in the table of digital chronologies (circular counter)
48	CrdSize		Datalogging: size of the table of digital chronologies (see RTU properties → General)
49	CraIndex		Datalogging: current position in the table of analog chronologies (circular counter)
50	CraSize		Datalogging: size of the table of analog chronologies (see RTU properties → General)
51	CreIndex		Datalogging: current position in the table of events (circular counter)
52	CreSize		Datalogging: size of the table of events (see RTU properties → Advanced Alarms properties)

(*) System variable 15. 'Week of the year' :

This system variable indicates the week of the year according to the date in the RTU.

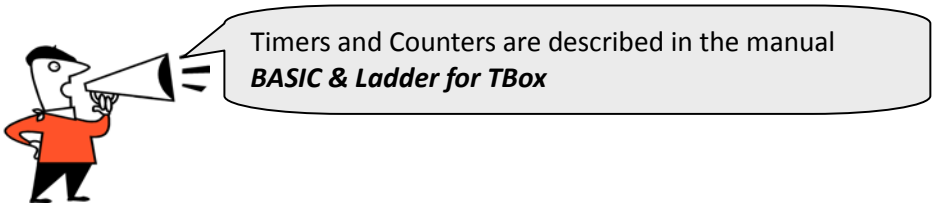
The rules are the following:
- the changing of week happens on Monday, 00:00 AM
- the changing of week happens at January 1, whatever day it is
- if January 1, is a Friday, Saturday or Sunday, there will be two 'Week 1'

Examples:

Month	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Week
dec	..	..	..	17	18	19	20	50
dec	21	22	23	24	25	26	27	51
dec / jan	28	29	30	31	1	2	3	52 / 1
jan	4	5	6	7	8	9	10	1
jan	11	12	..	..	..			2

Month	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Week
dec	..	..	..	18	19	20	21	50
dec	22	23	24	25	26	27	28	51
dec / jan	29	30	31	1	2	3	4	52 / 1
jan	5	6	7	8	9	10	11	2
jan	12	13	..	..	..			3

8.9. Timers & Counters



9. Tags

A Tag is essential for any programming

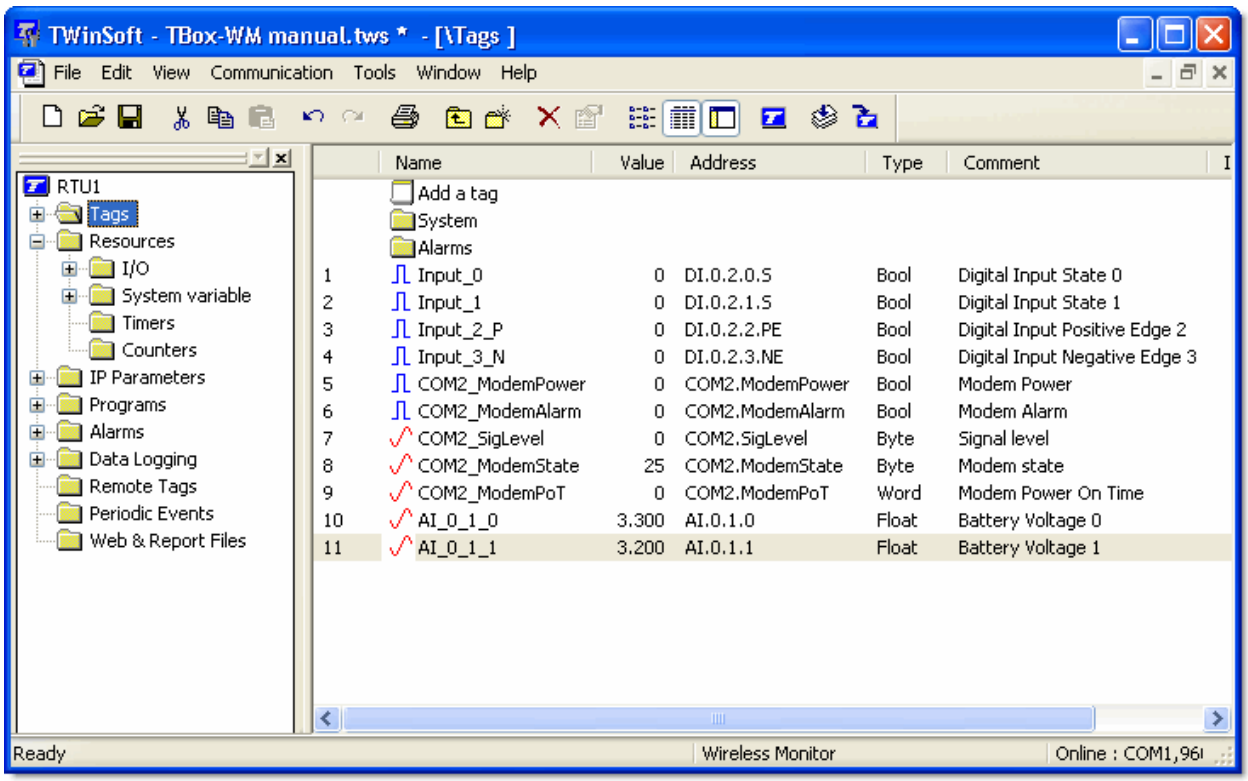
- An alarm is conditioned from a Tag.
- The Datalogging mechanism records values of Tags.
- BASIC/Ladder logic executes a process by handling Tags.
- …

Any variable of the **TBox ULP** that you want to use in any configuration, **you have to declare it as a Tag**.

There are 4 types of variables:

- The **Physical I/O** (DI, DO, AI, AO)
- The **System Variables** (predefined analog and digital functions)
- The **Internal Variables**, digital, analog and text (aka Registers)
- The **Communication Variables**, digital and analog

The Tags are gathered in the folder **Tags** of the Project Workspace:


TWinSoft - TBox-WM manual.tws * - [\Tags]
File Edit View Communication Tools Window Help
RTU1
Tags
Resources
I/O
System variable
Timers
Counters
IP Parameters
Programs
Alarms
Data Logging
Remote Tags
Periodic Events
Web & Report Files
Name Value Address Type Comment
Add a tag
System
Alarms
1 Input_0 0 DI.0.2.0.S Bool Digital Input State 0
2 Input_1 0 DI.0.2.1.S Bool Digital Input State 1
3 Input_2_P 0 DI.0.2.2.PE Bool Digital Input Positive Edge 2
4 Input_3_N 0 DI.0.2.3.NE Bool Digital Input Negative Edge 3
5 COM2_ModemPower 0 COM2.ModemPower Bool Modem Power
6 COM2_ModemAlarm 0 COM2.ModemAlarm Bool Modem Alarm
7 COM2_SigLevel 0 COM2.SigLevel Byte Signal level
8 COM2_ModemState 25 COM2.ModemState Byte Modem state
9 COM2_ModemPoT 0 COM2.ModemPoT Word Modem Power On Time
10 AI_0_1_0 3.300 AI.0.1.0 Float Battery Voltage 0
11 AI_0_1_1 3.200 AI.0.1.1 Float Battery Voltage 1
Ready
Wireless Monitor
Online : COM1,96

The Tags can be sorted into **Groups of Tags**.

- From the list of Tags, right click.
- From the Context menu, select 'New → Group'.
- You can then move/create Tags into the Group.

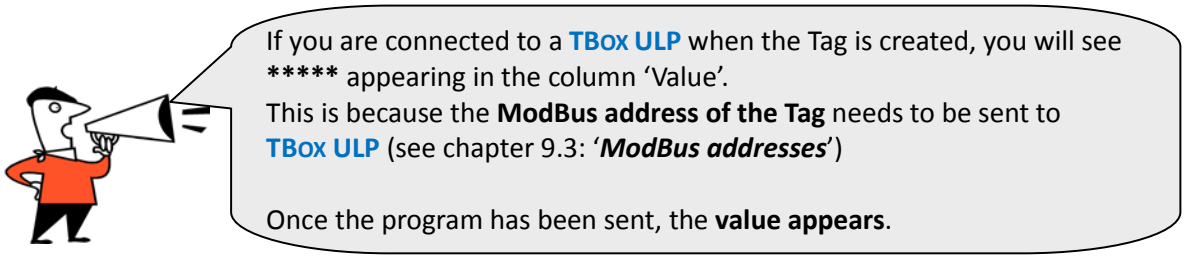
9.1. Physical I/O

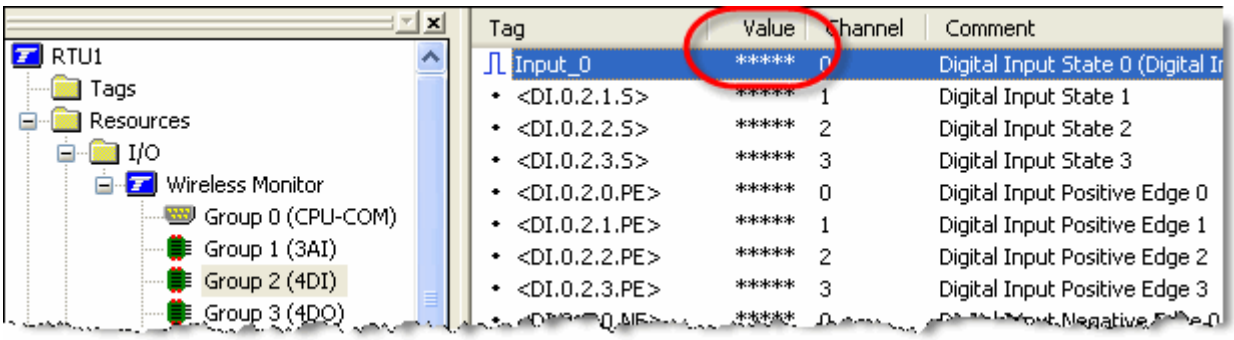
The physical I/O's are the signals available on I/O cards. They can be easily accessed from the 'Resources' (see also chapter 8: ***'The Resources'***).

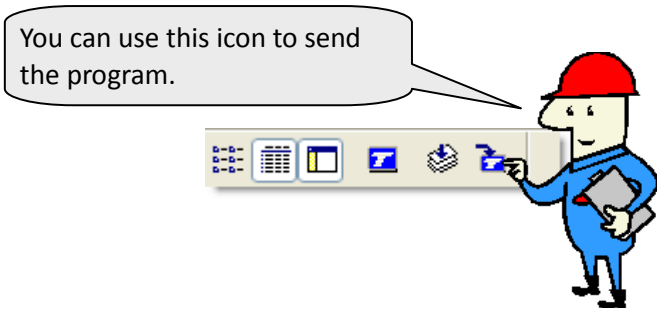
Details about the different I/O are available in chapters 8.7 and 17.9.

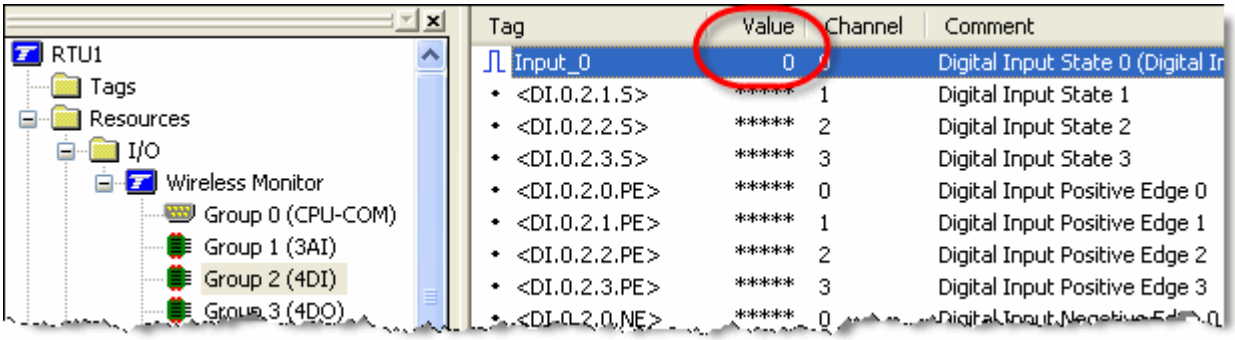
To create a Tag of a variable from the Resources:

- select it into the list and double click it
- change its name and description
- click <OK>


If you are connected to a TBox ULP when the Tag is created, you will see ***** appearing in the column 'Value'.
This is because the ModBus address of the Tag needs to be sent to TBox ULP (see chapter 9.3: 'ModBus addresses')
Once the program has been sent, the value appears.







9.2. *Internal Variables (Registers)*

An internal variable (also know as Register) is an addressable location of the memory. It is used as flag, as temporary value, to make a calculation, …

There are 3 types of internal variables:

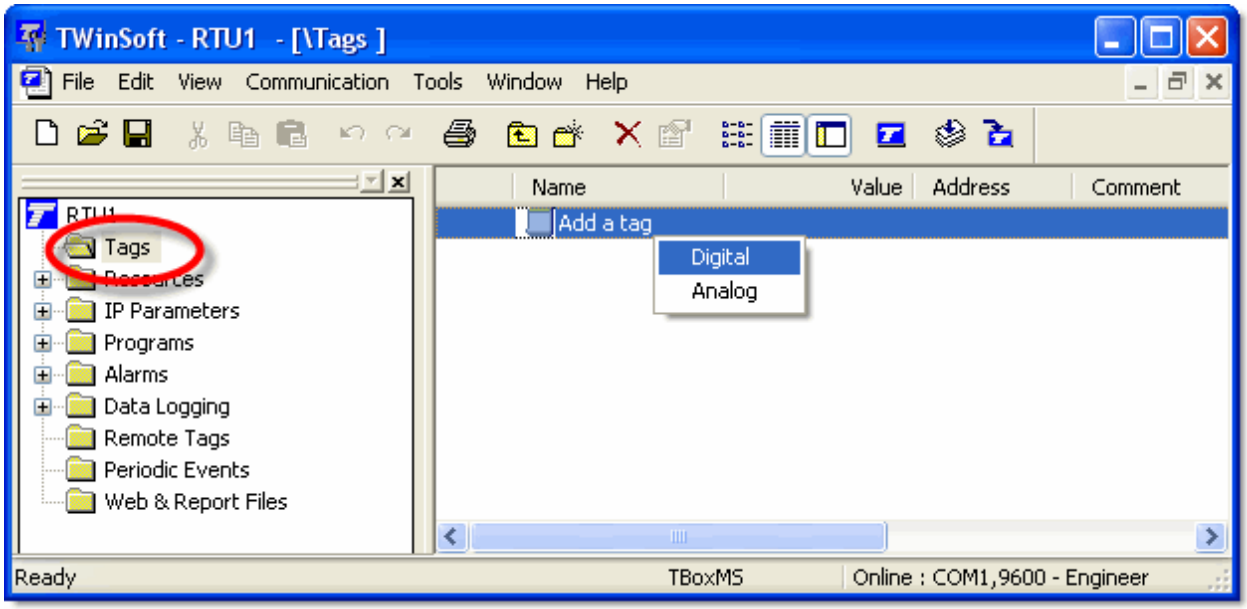
- **Digital (DIV)** Boolean register with possible values: 0 or 1.
- **Analog (AIV)** with several formats:
  - 8 bits, Signed or Unsigned
  - 16 bits, Signed or Unsigned
  - 32 bits, Signed or Unsigned
  - 32 bits Float, IEEE 754
- **TEXT (AIV)** analog register associated to a string of characters

The internal variables can be only created from the list of Tags.

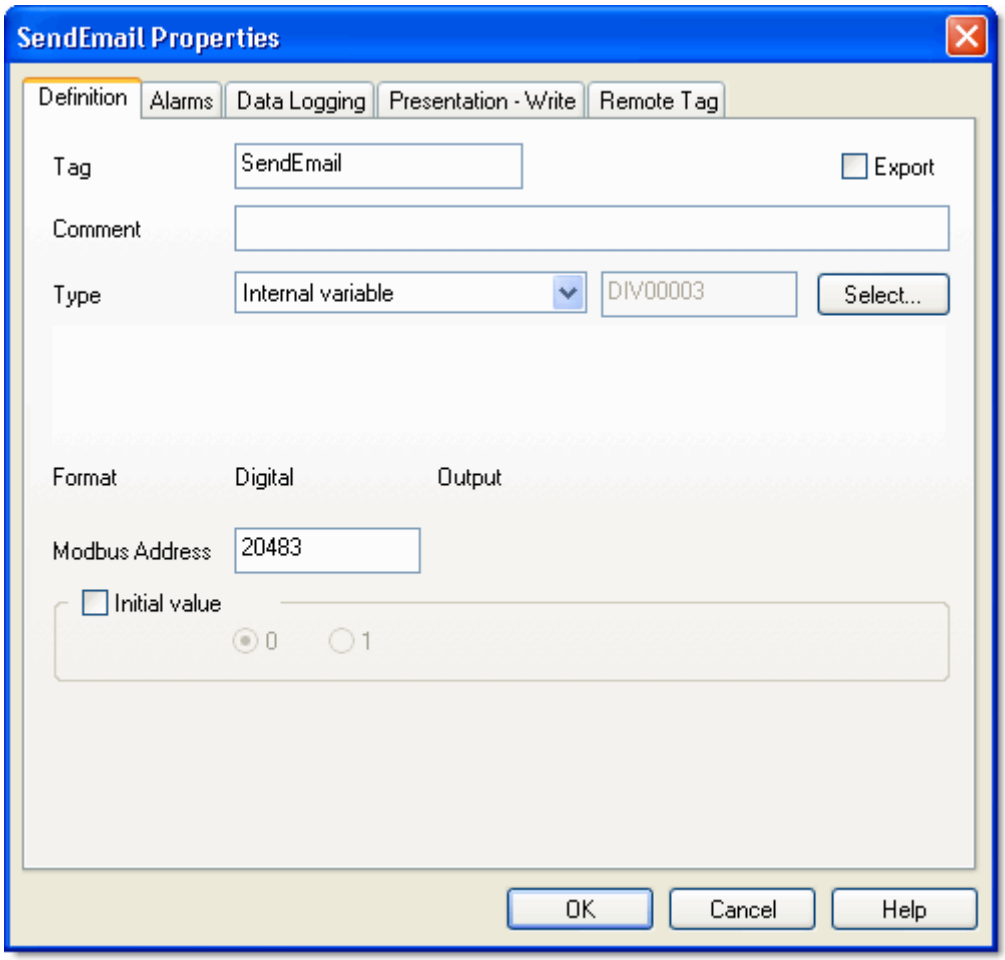
9.2.1. Digital Internal Variable

To create a Digital Internal Variable, from the list of Tags, click '*Add a Tag*' .

Select *'Digital'*

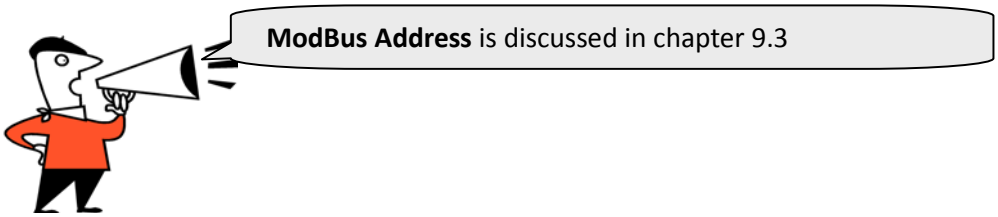


The Definition menu pops up:



You type a **Tag Name**, a **Comment** and select as **Type: 'Internal Variable'**

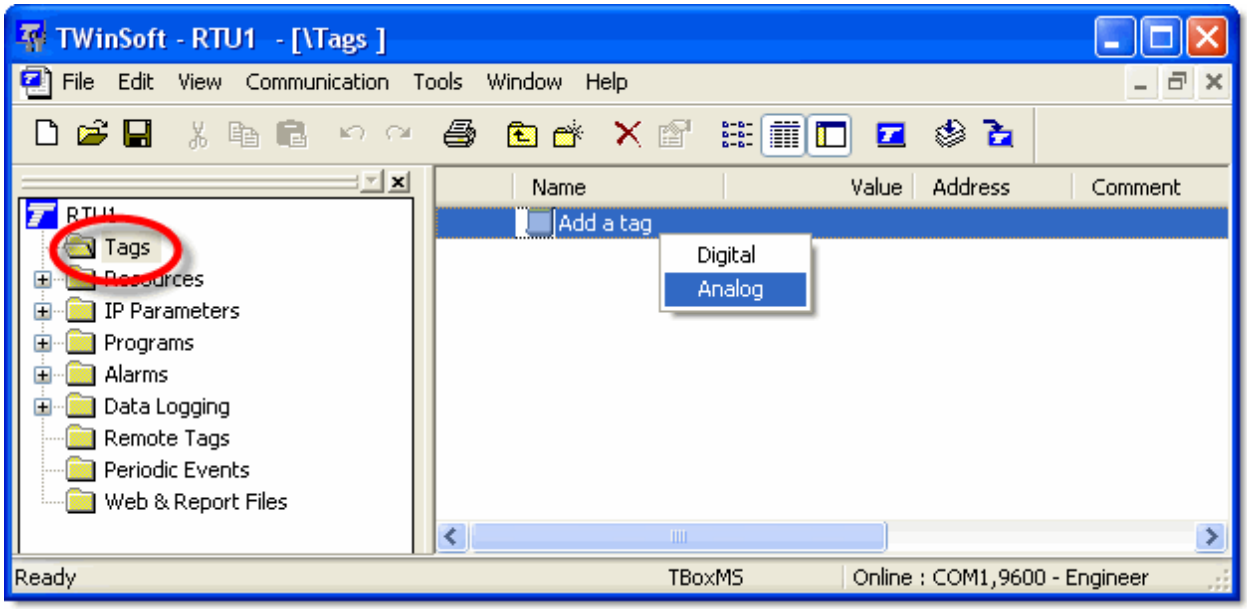
The **initial value** is the value the Tag will have at the start-up of ***TBox ULP***.
If you select *'None'* **the value is maintained** at start-up.



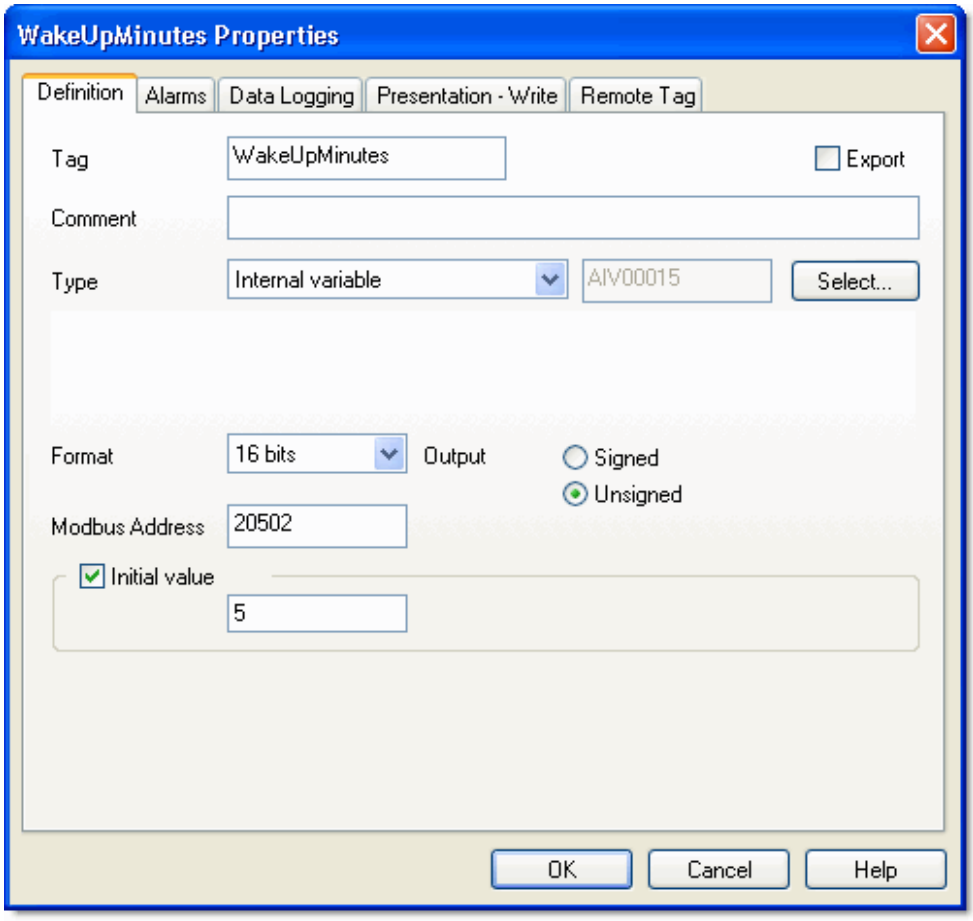
9.2.2. Analog Internal Variable

To create an Analog Internal Variable (also known as Register), from the list of Tags, click *'Add a Tag'* .

Select *'Analog'*



The Definition menu pops up:

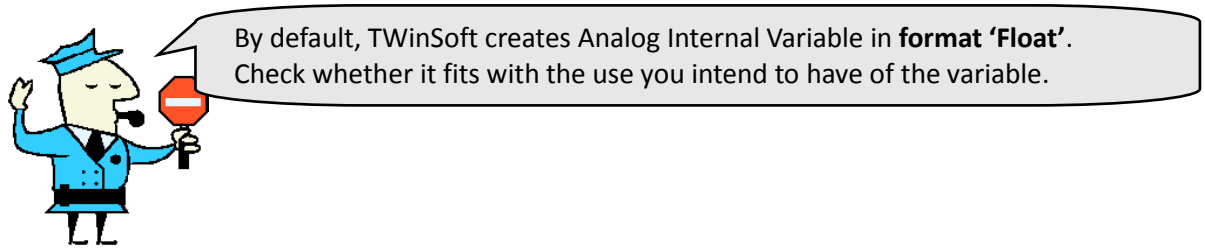


Example with a '16 bits – Unsigned' internal variable

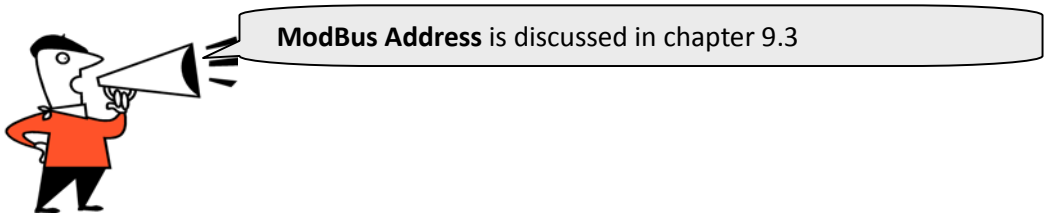
You type a Tag Name, a Comment and select as Type: 'Internal Register'

For each Analog Register, the formats available are:

- 8 bits (Signed or Unsigned)
- 16 bits (Signed or Unsigned)
- 32 bits (Signed or Unsigned)
- Float (32 bits, IEEE 754)


By default, TWinSoft creates Analog Internal Variable in **format 'Float'**.
Check whether it fits with the use you intend to have of the variable.

The **initial value** is the value the Tag will have at the start-up of ***TBox ULP***.
If you leave the field empty, **the value is maintained** at start-up.

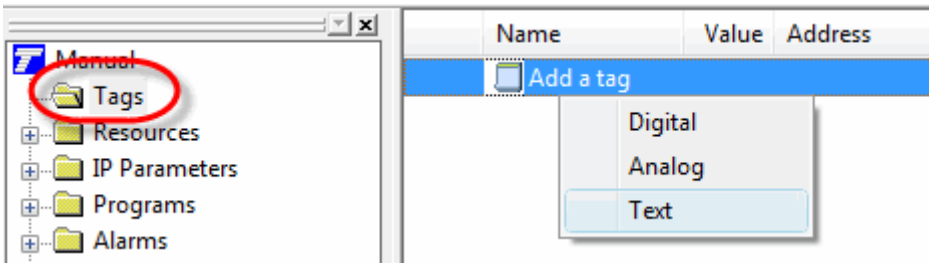


9.2.3. Text Internal Variable

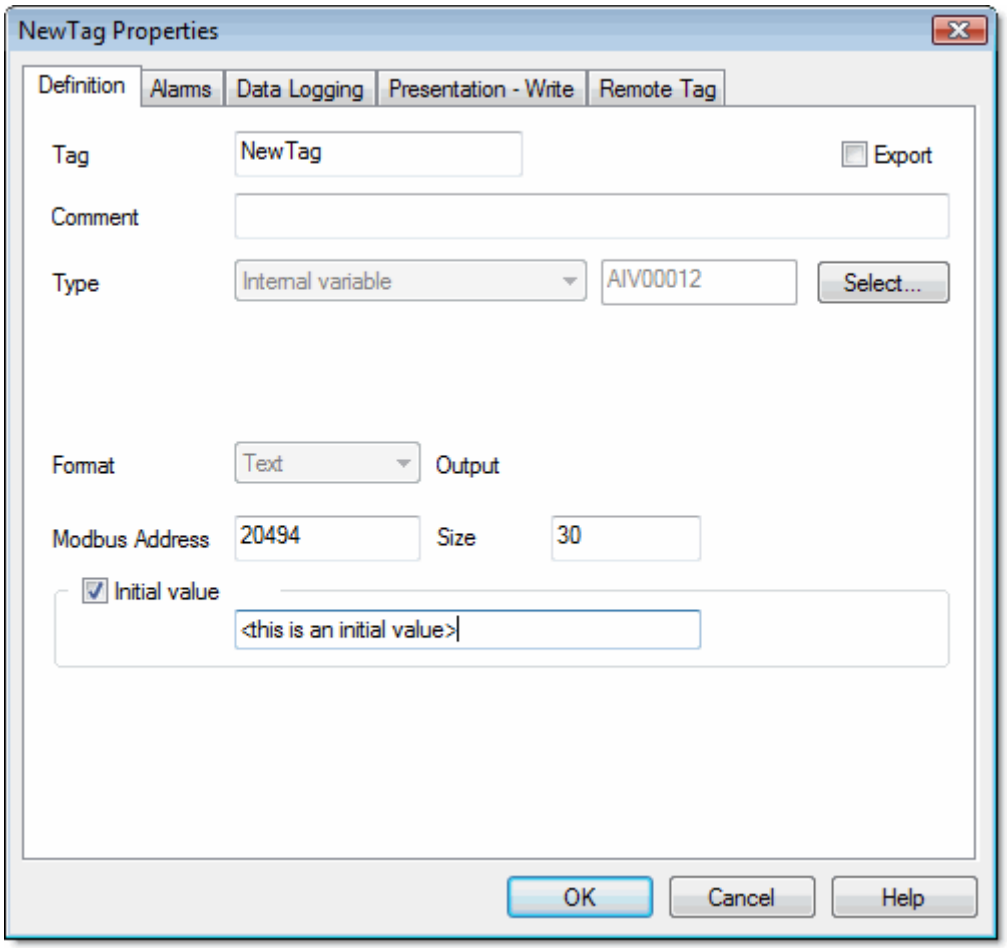
The Tag TEXT uses ASCII character encoding **ISO/CEI 8859-1** of the Latin alphabet.

To create a Tag TEXT (string of characters), from the list of Tags, click '*Add a Tag*' .

Select '*Text*'



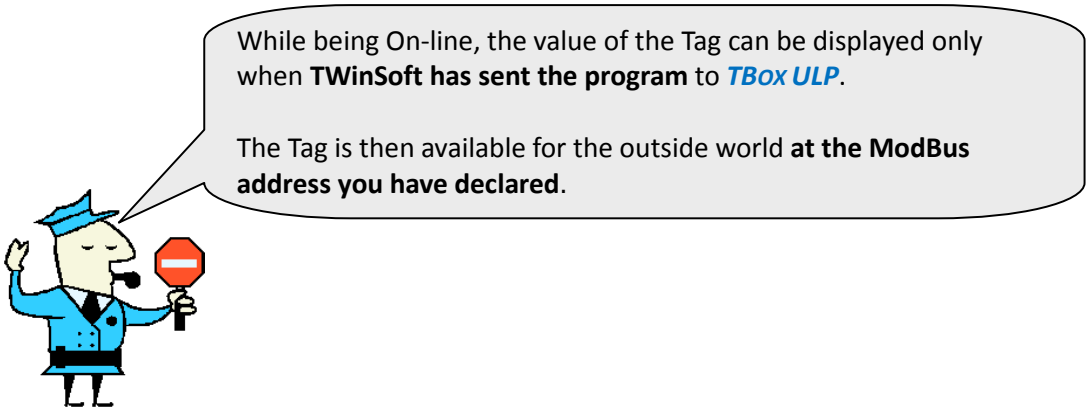
The Definition menu pops up:



9.3. ModBus address

The ModBus address is the **link to the outside world**. When equipment must sample Tags in ***TBox ULP***, it uses its ModBus addresses; like Tview , SCADA or TWinSoft.

Each **Tag has a unique ModBus address**. By default TWinSoft proposes a ModBus address.
You can change it if you want.


While being On-line, the value of the Tag can be displayed only when **TWinSoft has sent the program** to ***TBox ULP***.
The Tag is then available for the outside world **at the ModBus address you have declared**.

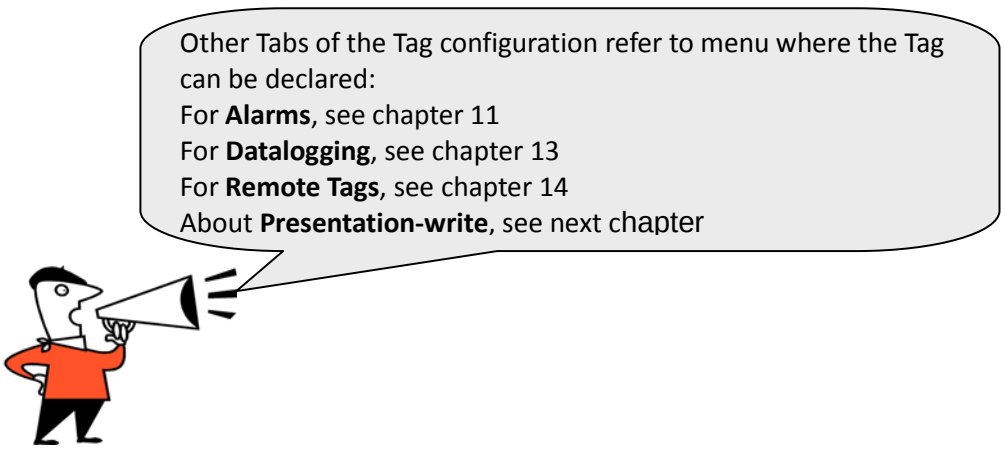
9.3.1. ModBus address of System Variables

With System Variables it is a little bit different; they have **two ModBus addresses**:

- One **internal and fixed** ModBus address. It explains why when you are connected to ***TBox ULP***, even without sending a program, you still can see values from the Resources.

The address of these variables is 65280 + ID of the variable.
Example: [AlaRec] = 65280+10=65290

- One **user** ModBus address that you are allowed to modify if you want. When you create a Tag of system variable, you can change its default ModBus address.
  In case you wish to access the Tag, you declare this **user** ModBus address.


Other Tabs of the Tag configuration refer to menu where the Tag can be declared:
For **Alarms**, see chapter 11
For **Datalogging**, see chapter 13
For **Remote Tags**, see chapter 14
About **Presentation-write**, see next chapter

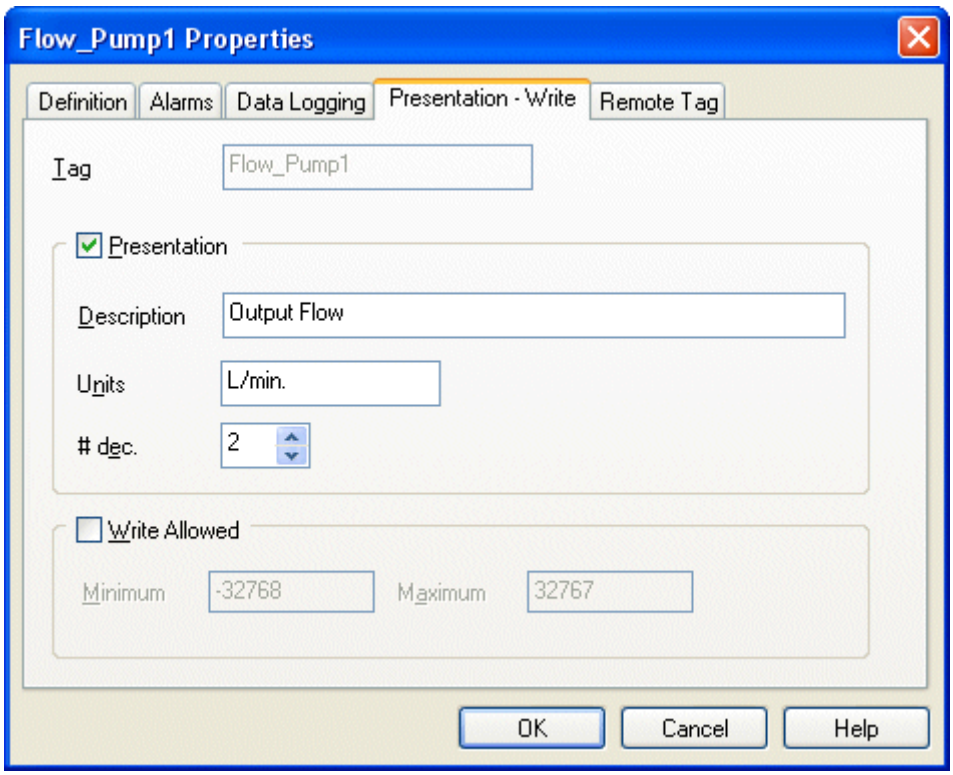
9.4. Tags - Presentation / Write

This tab contains configuration used when the Tag is declared in a **Report** or in a **WebForm**. The Description is also used in Tview
Presentation settings can also be used when the Tag value is included in a SMS.

- Report: file edited with 'Report Studio' and used for instance as text body when sending **e-mail**.
  (Start 'Report Studio' from 'Windows' and the group of Programs of Techno Trade or from the 'Project Workspace' and the list of 'Web and Report files')

- WebForm: file edited with 'WebForm studio'. Used to display values of Tags in a **HTML page**.
  (Start 'WebForm Studio' from 'Windows' and the group of Programs of Techno Trade or from the 'Project Workspace' and the list of 'Web and Report files')

- SMS: with Digital Tags, the 'states' defined here will be used and with Float Tags, the number of decimals.
  (See also chapter 11.6.1. ***Value of Tag in message***)



Presentation: makes the following information available to T, 'Report' and 'WebForm'.

Description: in a Report, text displayed as 'Header' in sampling table or as Tag information in chronologies when the data is retrieved.

Units: text displayed as 'Unit' in datalogging when the data is retrieved. It can also be displayed when selecting as format 'Value + unit' in the report or WebForm.

 # decimal: the quantity of decimals displayed

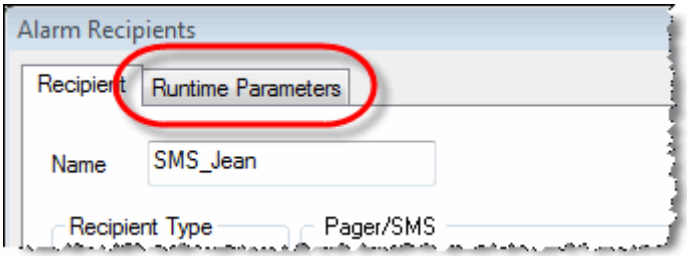
Write allowed: if the Tag is declared in a WebForm, allows defining a writing access to the Tag, within a specific range.

9.5. Run Time Parameters

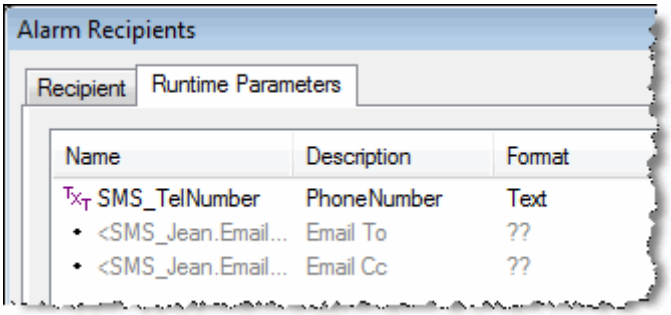
Run time parameters feature allows accessing some ***TBox ULP*** configurations through Tags, in order to modify them "on line".
For instance, to change a **tel. number** of a SMS recipient, the **e-mail address** of a recipient, the address of **SMTP server**, the **handling** of a alarm condition.

When a configuration provides access to run time parameters, a tab is attached to the configuration.

Example with Alarm Recipient:



You will associate a Tag to the run time parameter you want to add.
The Tag, and therefore its associated parameter, can then be modified from TWinSoft, a WebForm, a SCADA, ...



The format of the Tag depends on the parameter (Bool, Byte, Word, Float, Text)

Changing of parameters is maintained in case of **power cycle**, **reset**, **reboot** and **watchdog**.
Original configuration is restored in case of **sending new program or OS** and doing **stop/start from TWinSoft**.

9.5.1. Alarm Parameters

Alarm Condition

Parameter	Choice	Tag Format
Inhibition	0 = enabled 1 = disabled 2 = power fail 3 = DisAla 4 = DisAla2 5 = DisAla3 6 = DisAla4	Byte
Threshold (analog)		Byte or Word or DWord or Float
Hysteresis (analog)		Byte or Word or DWord or Float

Alarm Recipient

Parameter	Recipient Type	Tag Format
Phone Number E-mail To E-mail Cc	ModBus, SMS, Printer, RAS, Custom Email Email	Text Text Text

Alarm Time Slices

Parameter	Tag Format
From Hour From Min To Hour To Min	Byte Byte Byte Byte

Alarm Holidays

Parameter	Tag Format
Day Month Year	Byte Byte Word

9.5.2. Datalogging Parameters

Chronologies Condition

Parameter	Choice	Tag Format
Inhibition	0 = enabled 1 = disabled 2 = power fail 3 = DisCra/DisCrd	Byte
Variation (analog)		Byte or Word or DWord or Float

9.5.3. IP Parameters

ISP

Parameter	Tag Format
Phone Number	Text
User Name	Text
Password	Text

FTP

Parameter	Tag Format
Host	Text
TCP Port	Word
User Name	Text
Password	Text

SMTP

Parameter	Tag Format
Server	Text
TCP Port	Word
E-mail From	Text
Authentication	Bool
Login	Text
Password	Text

POP3

Parameter	Tag Format
Server	Text
TCP Port	Word
Authentication	Bool
Login	Text
Password	Text

NTP

Parameter	Tag Format
Server	Text

9.5.4. GSM/GPRS Parameters

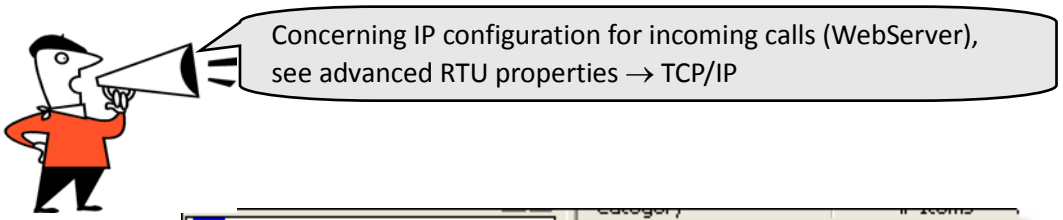
GPRS Authentication

Parameter	Tag Format
Authentication Login Password	Bool Text Text

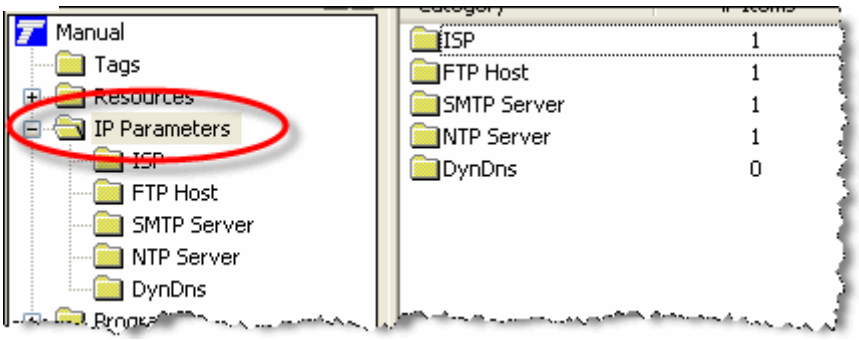
10. IP Parameters

IP parameters consist in the global configuration for:

- connecting to an ISP (dial-up connection)
- sending files (FTP)
- sending e-mail (SMTP)
- reading e-mail subject (POP3)
- Time synchronization (NTP)
- DynDNS (handling of public, dynamic IP addresses)



All IP parameters are defined in this Folder, available from the 'Resources'.



The FTP Host, SMTP Server, POP3 Server and NTP configurations correspond to connections to the appropriate servers. **It is done for once**, and called when creating a recipient of alarms.
This makes creating alarm recipients very easy !

Example with alarm for sending e-mail:

The **Recipient** is of type 'e-mail' with the e-mail address and it refers to a **SMTP server.**
This SMTP server refers to an **ISP**

In other way round, when ***TBox ULP*** generates an e-mail, it sequences the tasks like following:

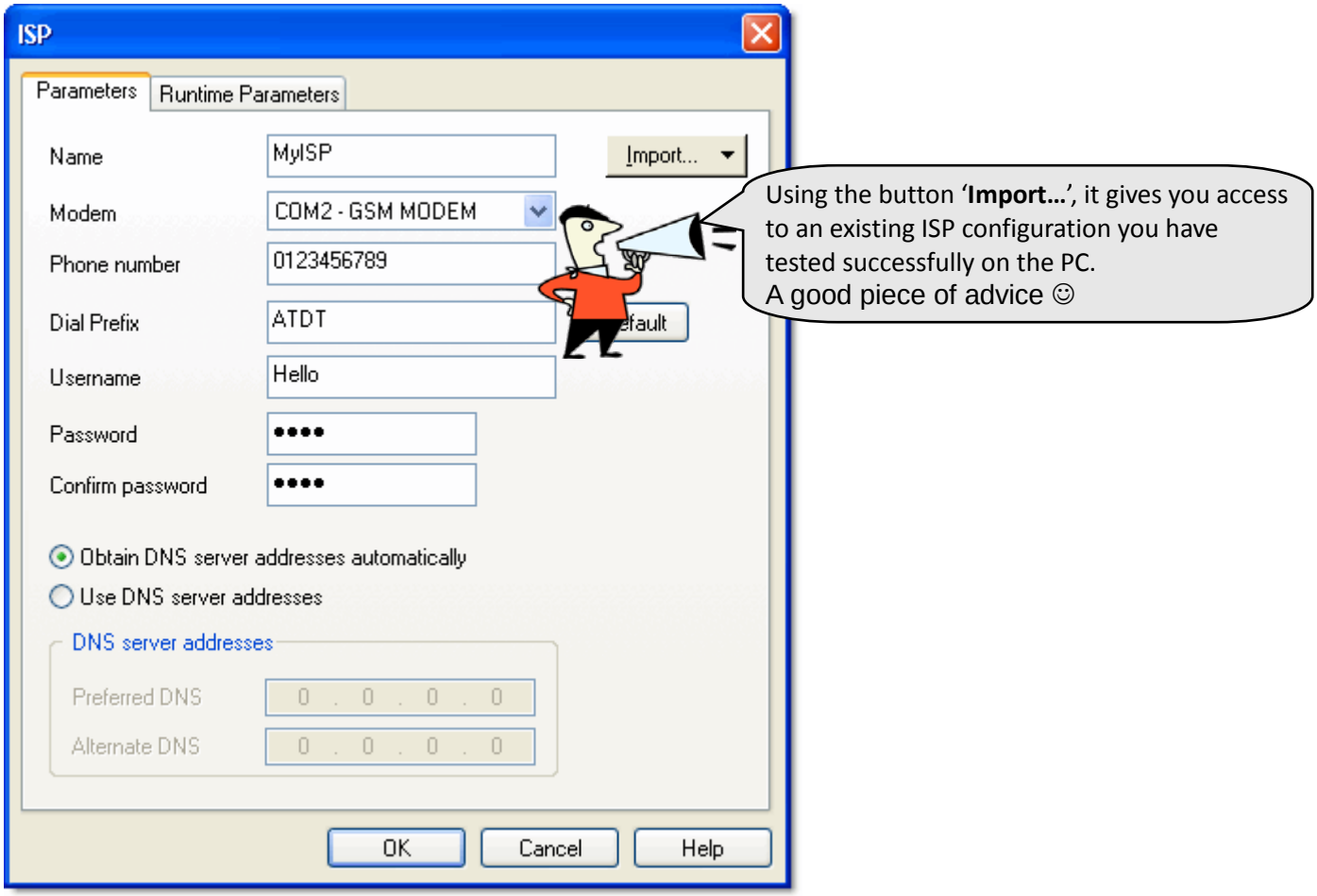
connection to an ISP → connection to a SMTP Server → sending to a recipient (e-mail address)

10.1. ISP configuration

ISP stands for **I**nternet **S**ervice **P**rovider. An ISP represents the entrance to Internet.
It is required to access Internet with a **dial-up connection** (GSM-DATA).

It represents the company you call to access an internet service, like sending e-mail or files (FTP). Some among the most well-known: At&T, Scarlet, Tiscali, …

When you want ***TBox ULP*** to send e-mail or to send files to a FTP site, through GSM-DATA connection, you have to subscribe an account to an ISP.



Name: It is the name of the provider.

Modem: a connection to an ISP is always carried out through modem. Select the modem.

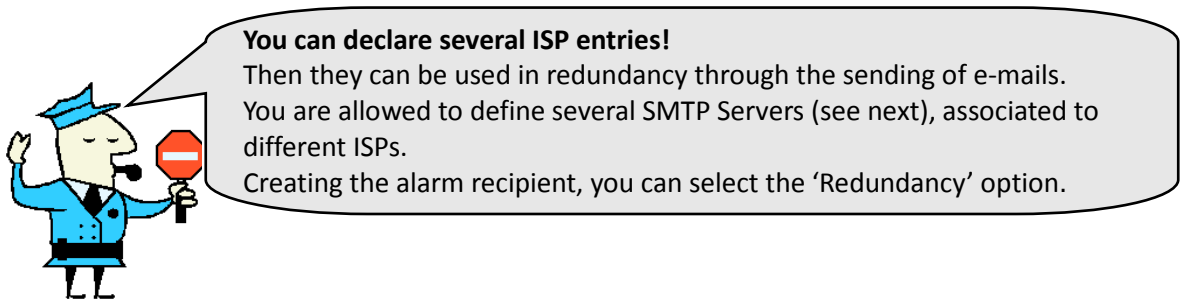
Phone number: It is the phone number of the provider the ***TBox ULP*** must dial to send an e-mail or files.

Dial Prefix: The default dial prefix to connect to the ISP (ATDT). **It should not be changed** unless the modem needs a particular configuration.

User name: It is the name of your account needed to access Internet (usually it is given by the ISP).

Password: It is the password of your account needed to access Internet (usually it is given by the ISP).

DNS: A DNS converts names in IP address. It is needed in case the the Server (SMTP, FTP, NTP, POP3) is indicated in 'text' and not with an IP address.
More and more ISPs support dynamic DNS, they provide the DNS addresses when connecting.
If this is not the case, they provide you with a 'Preferred' and 'Alternate' DNS address.

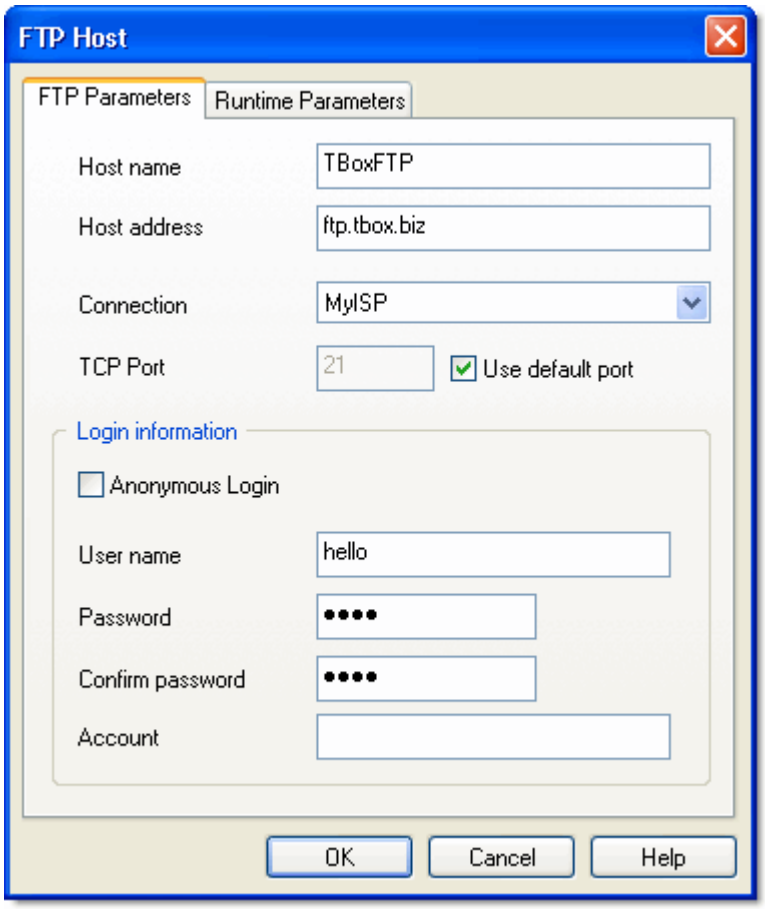

You can declare several ISP entries!
Then they can be used in redundancy through the sending of e-mails.
You are allowed to define several SMTP Servers (see next), associated to different ISPs.
Creating the alarm recipient, you can select the 'Redundancy' option.

10.2. FTP Host

FTP stands for **F**ile **T**ransfer **P**rotocol. When subscribing an account to an ISP, usually you have some Mbytes to your disposal for sending files.

The FTP host represents the target when sending files. The directory where the files are sent is defined in the Recipient (see chapter 11.4).

First, ***TBox ULP*** connects to Internet through an ISP or through GPRS and then sends the files.



Host Name: It is a free name, to recall when you create the alarm recipient

Host address: text and IP address are accepted.

Connection: You select the way to connect to the Server (ISP or GPRS).

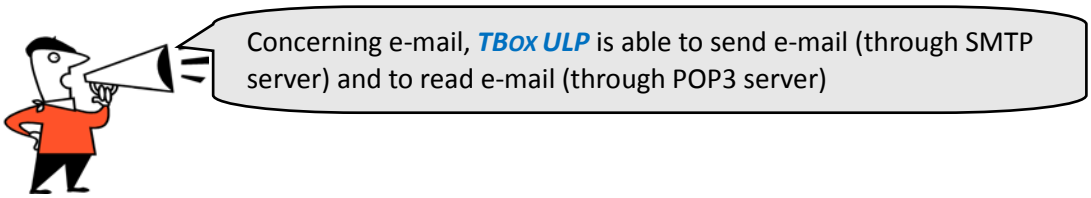
TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data. TCP port used by ***TBox ULP*** to establish FTP connection (default=21).

Login: Depending on the account you have subscribed, you have a login or work with 'Anonymous login'.

This is the basic configuration to connect to the 'FTP site'.
You **do not declare a directory** in this configuration, but when declaring the 'Recipient' (see chapter 11.4. ***The Recipients***).
This allows creating any combination:
- several 'FTP recipients' to one FTP site
- several 'FTP recipients' to different FTP sites.
- …

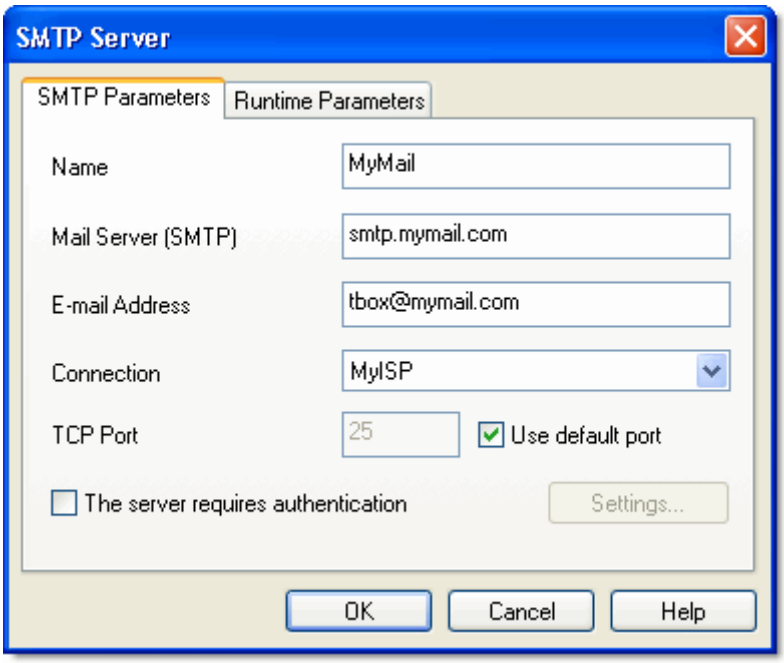
10.3. SMTP Server

SMTP stands for **S**imple **M**ail **T**ransfer **P**rotocol. It is usually the main reason for subscribing an account to an ISP, for sending e-mail.



The SMTP Server represents the mail server used for sending e-mail (typically the one of the ISP where we have subscribed and account).

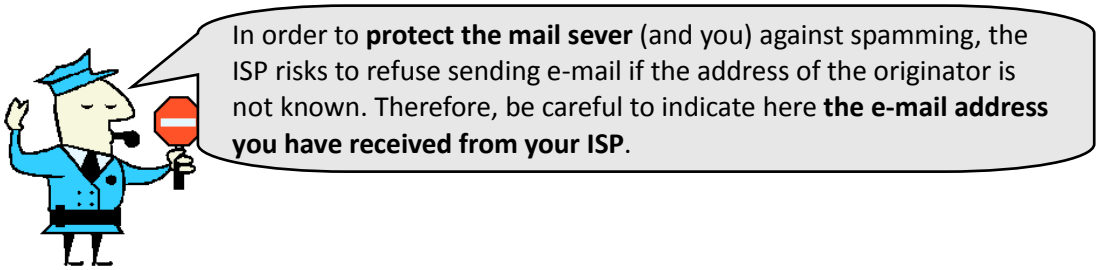
First, ***TBox ULP*** connects t to Internet through an ISP or through GPRS and then to the SMTP Server.



Name: It is a free name, to recall when you create the alarm recipient.

Mail Server (SMTP): It is the IP address (or the name) of the outgoing e-mail Server. It is the unique mail Server needed to send e-mails.

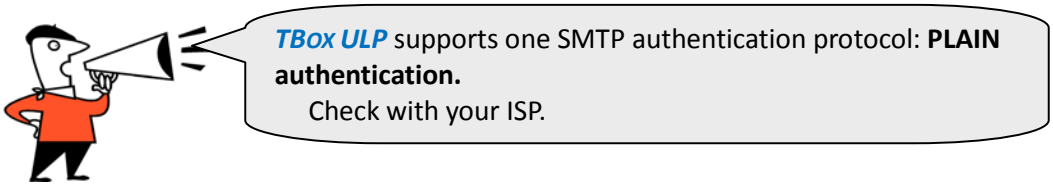
E-mail address: It is the e-mail address of the ***TBox ULP***. You can usually choose it when you subscribe an account. This address will appear in the 'From:' when receiving the e-mail.


In order to **protect the mail sever** (and you) against spamming, the ISP risks to refuse sending e-mail if the address of the originator is not known. Therefore, be careful to indicate here **the e-mail address you have received from your ISP**.

Connection: You select the way to connect to the Server (ISP or GPRS).

TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data.
TCP port used by ***TBox ULP*** to establish SMTP connection (default=25).

The Server requires Authentication: Depending on your ISP and on the way you send e-mail, authentication might be needed to send e-mail.
Usually, when you have subscribed the e-mail account at your ISP it is not required.
To be sure, if you have created this account to a PC, check its configuration otherwise contact your ISP.



10.3.1. About Redundancy

If you create more than one SMTP Server, they can be used in redundancy according to their order in the list.
You decide to work with redundancy when creating the e-mail recipient (see chapter 11.4).

10.4. POP3 Server

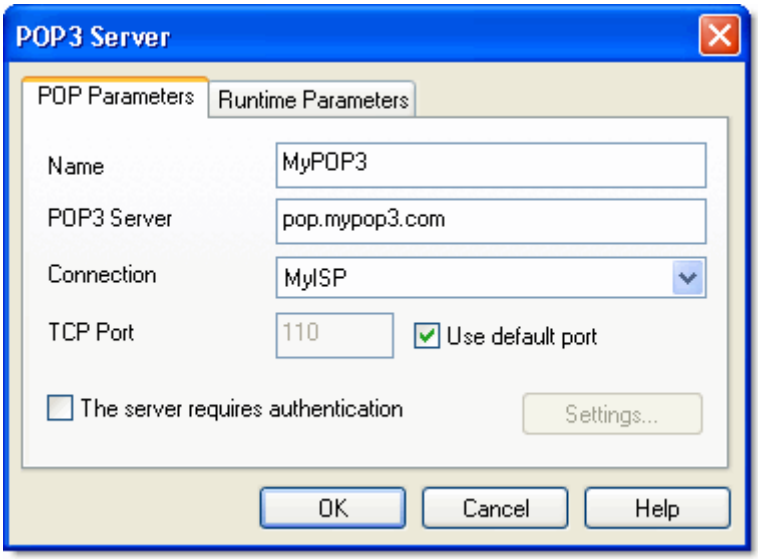
POP3 stands for **P**ost **O**ffice **P**rotocol 3. It is used to check and collect e-mails in a mail box.

The POP3 Server represents the mail server used to read mails previously sent to the attention of ***TBox ULP***.

The use of POP3 is not to retrieve e-mail, but to read the field "Subject" and to take some actions.
Two actions can be taken by sending e-mail to TBox:

1. Alarm acknowledgment sent through e-mail (see next page)
2. RTU monitoring with predefine message (see chapter 12. ***ReadSMS***)

First, ***TBox ULP*** connects to Internet through an ISP or through GPRS and then to the POP3 Server.



Name: It is a free name, to recall when you create the alarm recipient.

POP3 Server: It is the IP address (or the name) of the POP3 Server to which ***TBox ULP*** connects to read e-mails.

Connection: You select the way to connect to the Server (ISP or GPRS).

TCP port: Each TCP/IP service has its own unique TCP port. It provides a logical location for the delivery of TCP data.
TCP port used by ***TBox ULP*** to establish POP3 connection (default=110).

The Server requires Authentication: If authentication required to collect e-mail: Login and Password.
TBox ULP does not support SSH.

10.4.1. Alarm Acknowledge Through POP3

Introduction

With the ***TBox ULP*** sending a SMS through a GSM, it is possible to acknowledge the alarm by sending back a SMS to ***TBox ULP***
In some cases, mostly working in GPRS, SMS can be sent through e-mail services. In return, it is then possible to acknowledge the alarm using POP3 connection.

Sequence of connections

1. ***TBox ULP*** sends an e-mail. The alarm condition has been configured with the option "**POP3 Ack**". It is important you have a dedicated e-mail account for your RTU. The data sent by e-mail can be a report or a message.
2. The recipient retrieves its e-mail. The field "Subject" of the e-mail is preceded with internal data: RTU Id **(I)** and Alarm index **(A)**
   Example of message: **#I460000020107,A00004# MyTBox: PUMP stopped**
3. The user sends back the e-mail. Typically, he will make a "Reply" and sends back the e-mail to the address as specified in point 1. above, in the SMTP server.
4. ***TBox ULP*** generates a POP3 connection (through alarm condition) and checks the presence of e-mail with specific data in field "Subject". With this data, ***TBox ULP*** knows which alarm for which RTU it can acknowledge.
   The POP3 connections have to be handled into your process and can be checked from System Variables (see below)

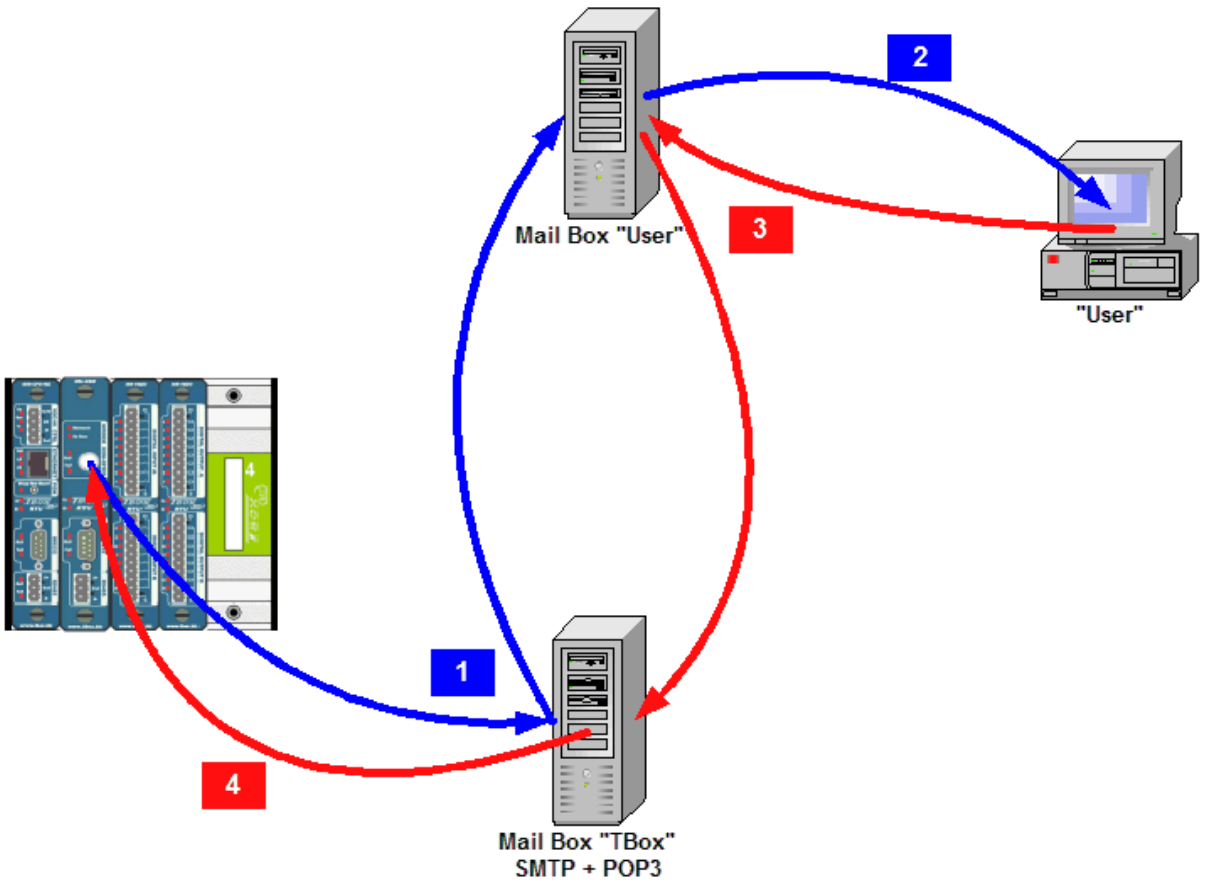


Illustration with a TBox MS

Supplementary information

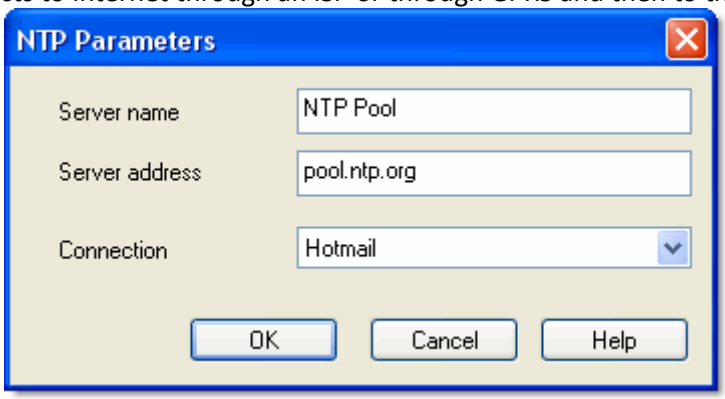
1. The time between phases 1 and 4 can be determined in RTU properties --> Advanced Alarms properties
2. System Analog Variable: #40 **[AlaPop3]** indicates the number of alarm needing to be acknowledged by POP3 connection and #43 **[Pop3State]** indicates the state of connection.
3. If escalation is required, Group of recipients can be associated to the alarm condition
4. Like other alarms, failure in sending SMTP alarms can be checked using System Digital Variable: #06 **[AlaErr]** and System Analog Variable: #10 **[AlaRec]**
5. Error in POP3 connection can be detected also using System Digital Variable: #48 **[POP3Err]**

10.5. NTP Server

NTP stands for **N**etwork **T**ime **P**rotocol, an Internet standard protocol (built on top of TCP/IP) that assures accurate synchronization of the clock of ***TBox ULP***.

The NTP Server represents a server dedicated to time synchronization.

First, ***TBox ULP*** connects to Internet through an ISP or through GPRS and then to the NTP Server.



Example with a connection to Windows server through Ethernet

Examples of Servers:

time.windows.com
europe.pool.ntp.org

You will find valuable information, like lists of Servers with open access at:

www.ntp.org → public time server list

The organization pool.ntp.org proposes servers using DNS round robin, which make a **random selection from a pool** of open access time servers. This is good enough when working with ***TBox ULP***.

Round Robin DNS technique is used when the number of access to a server is unpredictable, to balance the use of IP addresses (load balancing technique).

10.5.1. Time accuracy

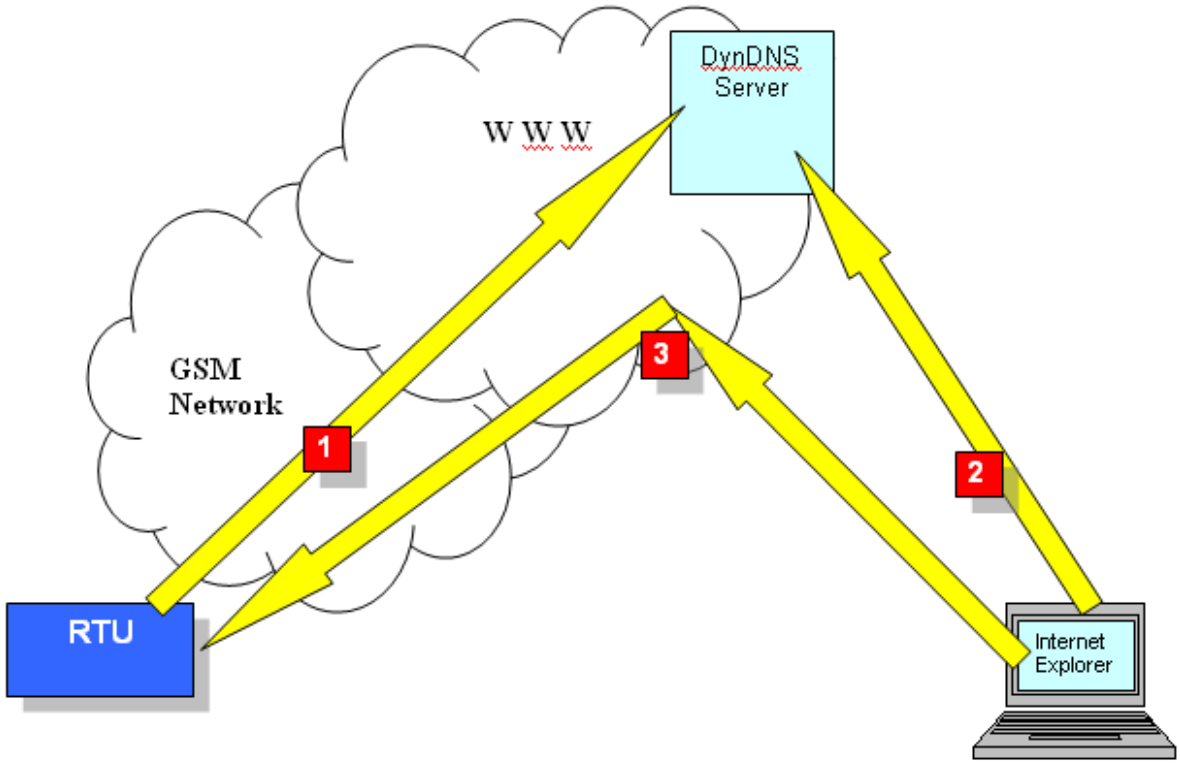
When setting time, ***TBox ULP*** takes into account the propagation delay. This is particularly important when connecting to the server via modem.

The precision is of **1 second**.

10.6. DynDNS

DynDNS stands for **Dyn**amic **D**ata **N**ame **S**erver.
It is a service, provided by the company DynDNS.org, offering the handling of **dynamic IP addresses**.
When working with GPRS connection, using public dynamic IP addresses, it is not possible to access the RTU directly, as you don't know its IP address.
The DynDNS service solves this problem: each time the RTU **detects a changing of its IP address**, it informs the DynDNS server.
You then connect to the DynDNS Server that will redirect you to the RTU.

Example of topology : connecting with Internet Explorer to a RTU having a **GPRS dynamic IP address**.



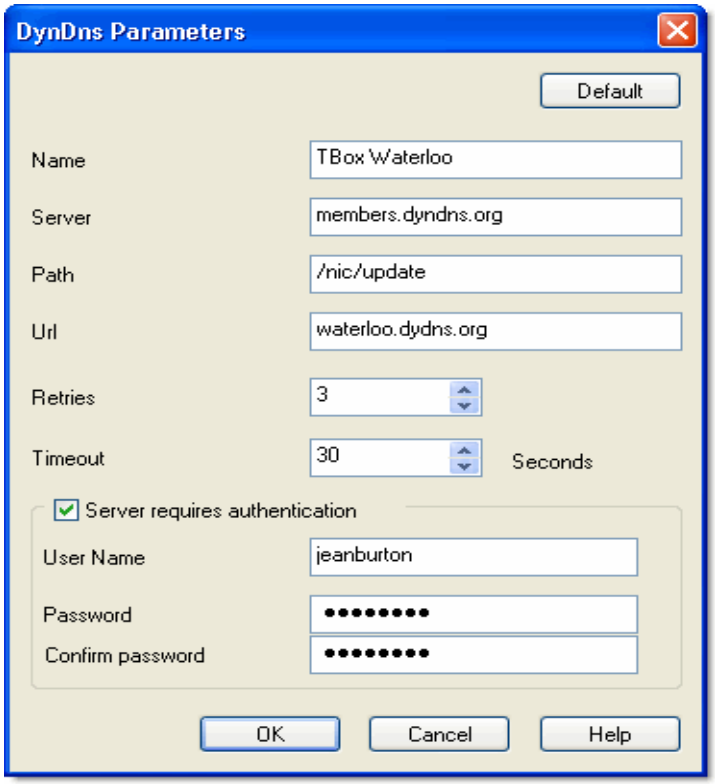
Sequence:

1. Detecting a changing in its IP address, the RTU informs the DynDNS Server.
2. Internet Explorer connects to the DynDNS Server (example: **http://waterloo.dyndns.org**). The DynDNS Server resolves the name and sends back the corresponding IP address.
3. Internet Explorer connects to the IP address it has received.

10.6.1. How to configure DynDNS in TBox

1. Subscribe a DynDNS account:
   - Go to www.dydns.org
   - Create an Account
   - Create a Host

2. Create in TWinSoft IP Parameters the connection to DynDNS:



Name
Type any name

Server
DynDNS Server to which ***TBox ULP*** will connect when it detects a changing in its IP address. It should not be changed.

Path
Location in the server of the table of correspondences between IP address --> name. It should not be changed.

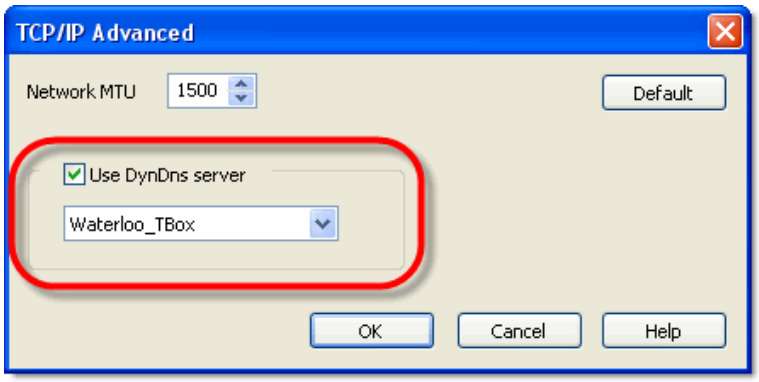
Url
You type the host address you have creating when subscribing the DynDNS account.
Example: waterloo.dyndns.org

Server requires authentication
Select the option to type the **login** corresponding to the account you have created at DynDNS organization.

User name
Type the login name of your account.

Password
Type the login password of your account.

3. Associate the DynDNS connection to the modem (see communication port: TCP/IP Advanced...)



10.7. TCP/IP Debugging

This feature is very convenient to trace problems when sending e-mails and/or files (with FTP).

It informs on the different steps of the connection: Login to the ISP, obtain of DNS, SMTP communication, …

It is based on 3 'System variables': TcpIpLog, PortIdLog and EventLog

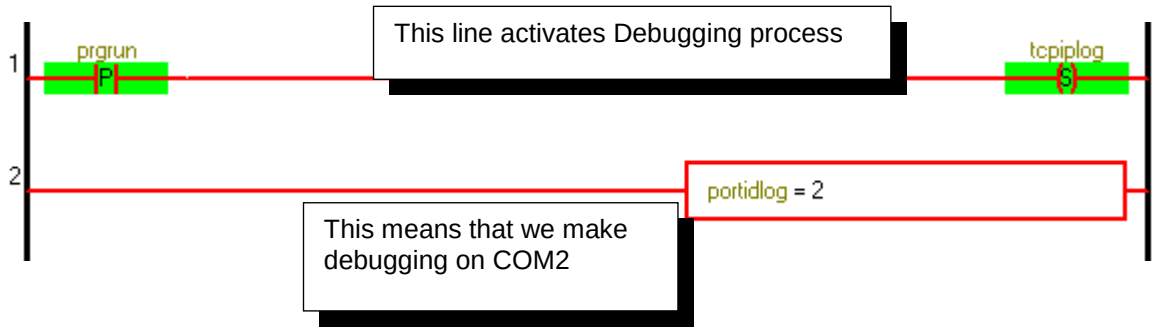
Procedure

1. One System variable must be Tagged: **Analog # 25: EventLog**

   Keep the ModBus address as it is (22080). Do not change it.

   It is not necessary to Tag the 2 other variables.

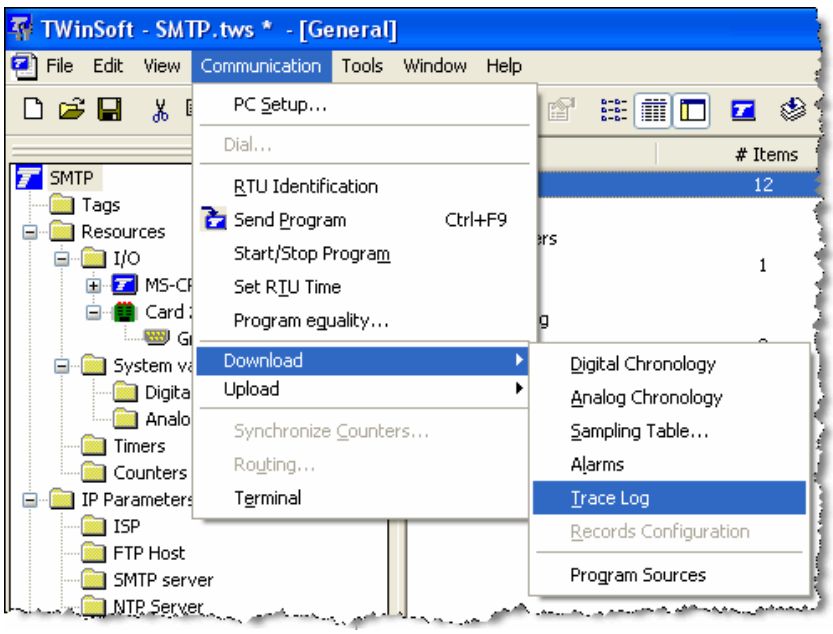
2. Make the following lines of Ladder:



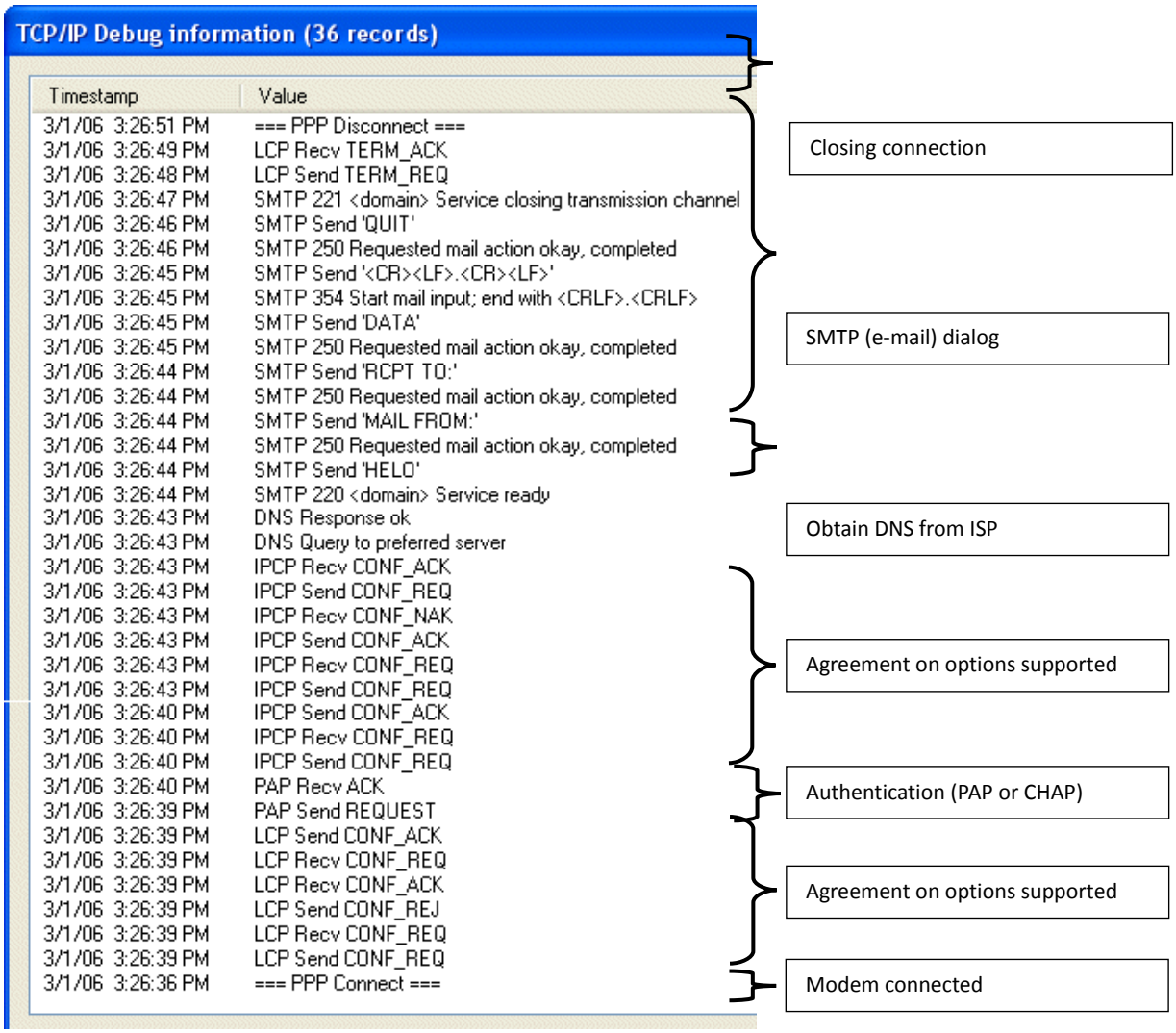
Example on debugging through LT-xxx with PSTN modem (COM2)

As you can see, we use the system variables without having Tagged them (brown color). You can also Tag them if you want.

3. Once the connection is finished, look at the trace from the 'Communication menu'



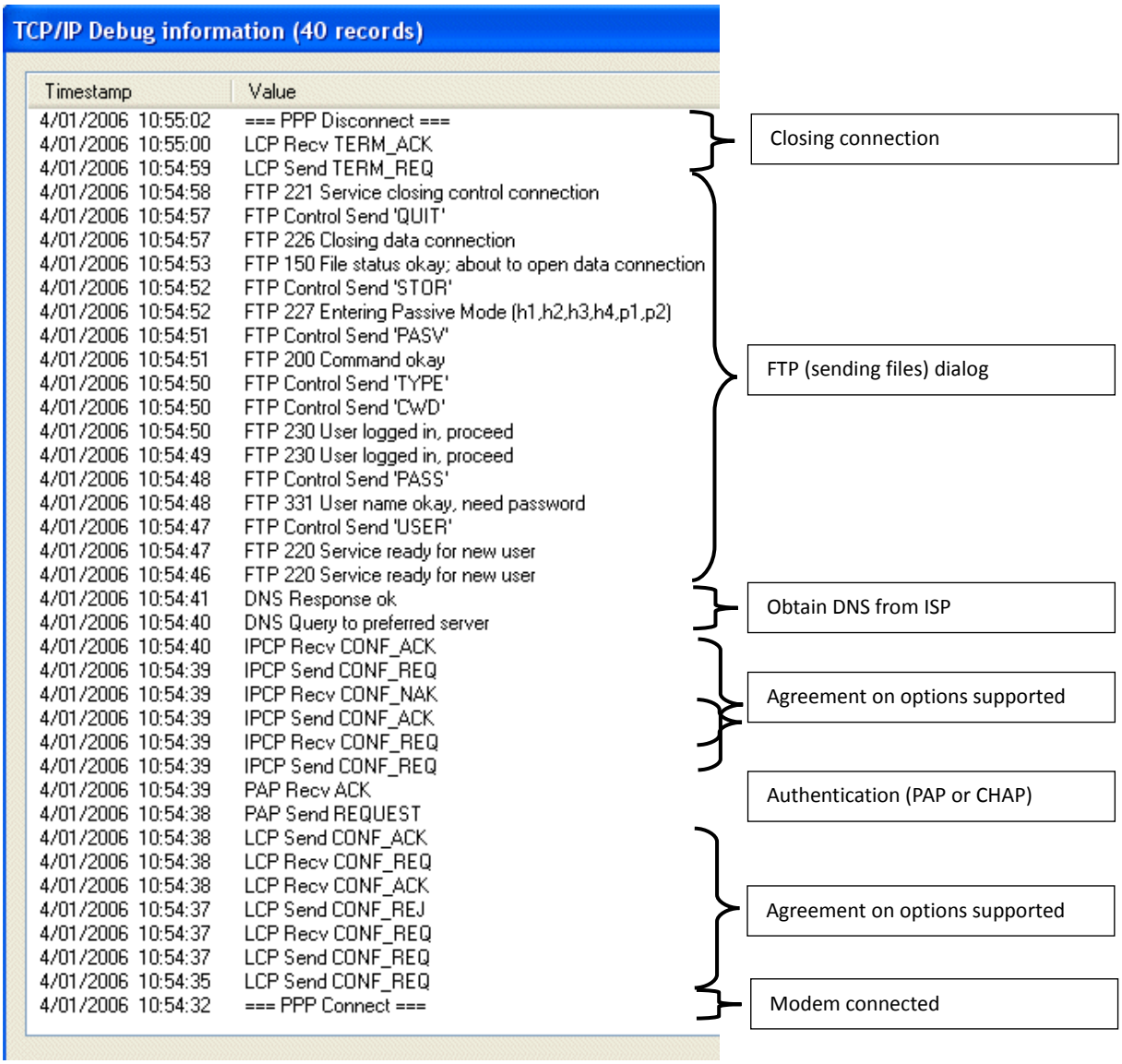
4. Once the connection is finished, look at the trace from the 'Communication menu'


TCP/IP Debug information (36 records)
Timestamp
Value
3/1/06 3:26:51 PM === PPP Disconnect ===
3/1/06 3:26:49 PM LCP Recv TERM_ACK
3/1/06 3:26:48 PM LCP Send TERM_REQ
3/1/06 3:26:47 PM SMTP 221 <domain> Service closing transmission channel
3/1/06 3:26:46 PM SMTP Send 'QUIT'
3/1/06 3:26:46 PM SMTP 250 Requested mail action okay, completed
3/1/06 3:26:45 PM SMTP Send '<CR><LF>.<CR><LF>'
3/1/06 3:26:45 PM SMTP 354 Start mail input; end with <CRLF>.<CRLF>
3/1/06 3:26:45 PM SMTP Send 'DATA'
3/1/06 3:26:45 PM SMTP 250 Requested mail action okay, completed
3/1/06 3:26:44 PM SMTP Send 'RCPT TO:'
3/1/06 3:26:44 PM SMTP 250 Requested mail action okay, completed
3/1/06 3:26:44 PM SMTP Send 'MAIL FROM:'
3/1/06 3:26:44 PM SMTP 250 Requested mail action okay, completed
3/1/06 3:26:44 PM SMTP Send 'HELO'
3/1/06 3:26:44 PM SMTP 220 <domain> Service ready
3/1/06 3:26:43 PM DNS Response ok
3/1/06 3:26:43 PM DNS Query to preferred server
3/1/06 3:26:43 PM IPCP Recv CONF_ACK
3/1/06 3:26:43 PM IPCP Send CONF_REQ
3/1/06 3:26:43 PM IPCP Recv CONF_NAK
3/1/06 3:26:43 PM IPCP Send CONF_ACK
3/1/06 3:26:43 PM IPCP Recv CONF_REQ
3/1/06 3:26:43 PM IPCP Send CONF_REQ
3/1/06 3:26:40 PM IPCP Send CONF_ACK
3/1/06 3:26:40 PM IPCP Recv CONF_REQ
3/1/06 3:26:40 PM IPCP Send CONF_REQ
3/1/06 3:26:40 PM PAP Recv ACK
3/1/06 3:26:39 PM PAP Send REQUEST
3/1/06 3:26:39 PM LCP Send CONF_ACK
3/1/06 3:26:39 PM LCP Recv CONF_REQ
3/1/06 3:26:39 PM LCP Recv CONF_ACK
3/1/06 3:26:39 PM LCP Send CONF_REJ
3/1/06 3:26:39 PM LCP Recv CONF_REQ
3/1/06 3:26:39 PM LCP Send CONF_REQ
3/1/06 3:26:36 PM === PPP Connect ===
Closing connection
SMTP (e-mail) dialog
Obtain DNS from ISP
Agreement on options supported
Authentication (PAP or CHAP)
Agreement on options supported
Modem connected

TBox ULP uses the 'Analog Chronologies' to store debugging data:

- Check whether the size is sufficient (from the RTU properties ☐General)
- If you retrieve data, for instance with *Tview*, you might receive strange data!

5. Once the connection is finished, look at the trace from the 'Communication menu'


TCP/IP Debug information (40 records)
Timestamp
Value
4/01/2006 10:55:02 === PPP Disconnect ===
4/01/2006 10:55:00 LCP Recv TERM_ACK
4/01/2006 10:54:59 LCP Send TERM_REQ
4/01/2006 10:54:58 FTP 221 Service closing control connection
4/01/2006 10:54:57 FTP Control Send 'QUIT'
4/01/2006 10:54:57 FTP 226 Closing data connection
4/01/2006 10:54:53 FTP 150 File status okay; about to open data connection
4/01/2006 10:54:52 FTP Control Send 'STOR'
4/01/2006 10:54:52 FTP 227 Entering Passive Mode (h1,h2,h3,h4,p1,p2)
4/01/2006 10:54:51 FTP Control Send 'PASV'
4/01/2006 10:54:51 FTP 200 Command okay
4/01/2006 10:54:50 FTP Control Send 'TYPE'
4/01/2006 10:54:50 FTP Control Send 'CWD'
4/01/2006 10:54:50 FTP 230 User logged in, proceed
4/01/2006 10:54:49 FTP 230 User logged in, proceed
4/01/2006 10:54:48 FTP Control Send 'PASS'
4/01/2006 10:54:48 FTP 331 User name okay, need password
4/01/2006 10:54:47 FTP Control Send 'USER'
4/01/2006 10:54:47 FTP 220 Service ready for new user
4/01/2006 10:54:46 FTP 220 Service ready for new user
4/01/2006 10:54:41 DNS Response ok
4/01/2006 10:54:40 DNS Query to preferred server
4/01/2006 10:54:40 IPCP Recv CONF_ACK
4/01/2006 10:54:39 IPCP Send CONF_REQ
4/01/2006 10:54:39 IPCP Recv CONF_NAK
4/01/2006 10:54:39 IPCP Send CONF_ACK
4/01/2006 10:54:39 IPCP Recv CONF_REQ
4/01/2006 10:54:39 IPCP Send CONF_REQ
4/01/2006 10:54:39 PAP Recv ACK
4/01/2006 10:54:38 PAP Send REQUEST
4/01/2006 10:54:38 LCP Send CONF_ACK
4/01/2006 10:54:38 LCP Recv CONF_REQ
4/01/2006 10:54:38 LCP Recv CONF_ACK
4/01/2006 10:54:37 LCP Send CONF_REJ
4/01/2006 10:54:37 LCP Recv CONF_REQ
4/01/2006 10:54:37 LCP Send CONF_REQ
4/01/2006 10:54:35 LCP Send CONF_REQ
4/01/2006 10:54:32 === PPP Connect ===
Closing connection
FTP (sending files) dialog
Obtain DNS from ISP
Agreement on options supported
Authentication (PAP or CHAP)
Agreement on options supported
Modem connected

Values

The column 'Value' returns messages from/to the Server.

When there is a code, it is always information received **from the Server**:

2xx: OK

3xx: OK, but something still missing

4xx: temporary error

5xx: permanent error. When ***TBox ULP*** receives such a code, it stops communication and closes the socket.

11. Alarms

11.1. Introduction

Alarm module of ***TBox ULP*** is the gate to the outside world.

An alarm consists in a **communication event**, not only for sending warning messages but also to establish a connection, like we will see.

Via alarms, you are able to **call a SCADA**, send **SMS** or message to Pagers, send **e-mail**, send files to a **FTP** site, **dial** another ***TBox*** or **send a report** to a printer.

Alarms can be used also to **send historical data (datalogging)** on regular base using e-mail or FTP. The historical data is sent as the attached file of a report, developed using ***Report Studio*** (see from 'Windows' the group of programs of 'Techno Trade').
TView, the supervisory software can then be used to collect data from a mail box or a FTP site.

The initiation of alarms in the ***TBox ULP*** relies on the variation of digital or analog Tags.
For example, an intrusion contact or a flow level generates a call.

When the modem is in low power mode, it will be automatically powered if an alarm with severity "high" is detected at the wake-up of the CPU.

There are three basic configurations for an alarm:

- ***The condition:*** *a changing in a Tag.*
- **The recipient:** to whom the alarm is sent.
- **The message** (or report)**:** information to sent to the recipient.

Each new alarm is immediately entered into a **32-alarms queue** (adjustable) and processed, according to the availability of communication ports required and its severity level. Alarms are generated one by one. The alarm queue represents an **internal buffer of alarms**: if several alarms happen at the same time or if a communication port is not available when the alarm happens.

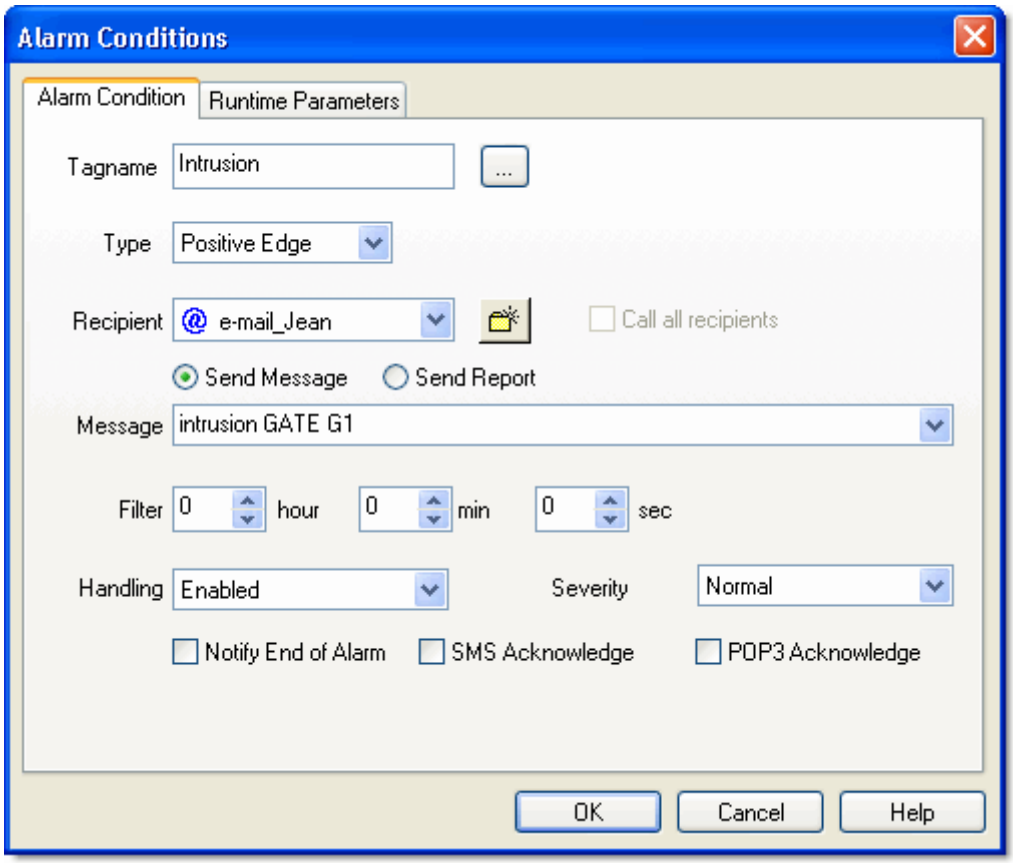
The **Events stack**, gives information about alarms status (Started – Stopped – Acknowledged).).

The **Events stack** is discussed in chapter 11.8

To access the definition of Conditions, click the folder 'Alarms' in the Project workspace and select 'Conditions'.

According to the Tag you select, you define a **digital alarm condition** or an **analog alarm condition**.

11.2. Digital Alarm Condition



Tagname: The Tag selected to generate the alarm.

Type: The edge on which the alarm is going to be started (rising, falling or both).

Message or Report: text or **file** associated to the alarm.
Depending on the type of recipient associated, you can send a message or a report. It can be a message sent to a GSM, a message or report sent as e-mail, to a printer or the file sent by FTP …

It always appears in the table of alarms, to distinguish them (see chapter 11.8.).

If the alarm condition sends an **e-mail**, it can be of 2 kinds:
Message: a text message is sent and it appears in the 'object' field of the e-mail
Report: sending of a report created with ***Report Studio***. The report can be created from the Project Workspace and the list of 'Web & Report files'.

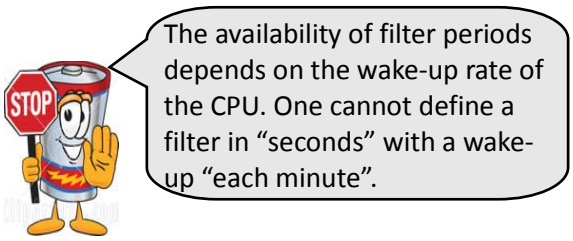
Recipient: Select a **Recipient** or a **group of recipients**. The 'person' you wish to contact in case of alarm (see 'Recipients' below).
In case you select a '**group of Recipients**' see next.

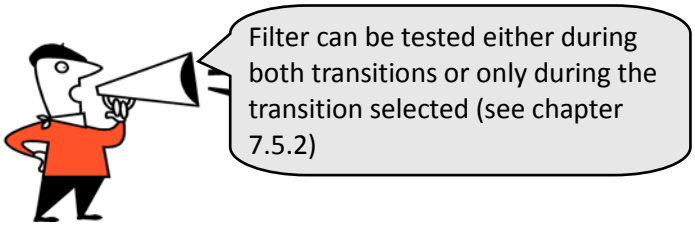
Call all Recipients: can be used when selecting a **Group of Recipients**.

When the option is cleared: ***TBox ULP*** calls the first one in the group. In case the alarm cannot be acknowledged after the number of tries, ***TBox ULP*** automatically calls the next recipient in the group and so on until it succeeds. Then it stops. (Also known as 'Chain')

When the option is checked: ***TBox ULP*** sends the alarm to all recipients of the group. (Also known as 'Link')

Filter: The time in hour:minute:second during which the condition must stay TRUE, before the call is generated.

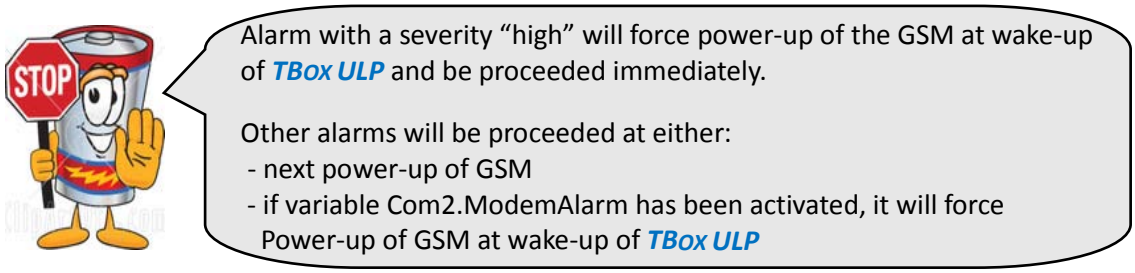

STOP
The availability of filter periods depends on the wake-up rate of the CPU. One cannot define a filter in "seconds" with a wake-up "each minute".



Handling: The handling option allows blocking each alarm condition, manually or automatically.

- Enabled: alarm condition always active.
- Disabled: alarm condition always de-activated.
- PowerF: alarm condition disabled when there is a main power failure.
- DisAla: alarm condition de-activated when the system variable 'DisAla' is at 1.

Severity: Each alarm can be assigned a level of severity: Low, Normal or High. When several alarms are still present in the queue and then not processed yet, ***TBox ULP*** generates the calls according to the highest severity.


STOP
Alarm with a severity "high" will force power-up of the GSM at wake-up of TBox ULP and be proceeded immediately.
Other alarms will be proceeded at either:
- next power-up of GSM
- if variable Com2.ModemAlarm has been activated, it will force Power-up of GSM at wake-up of TBox ULP

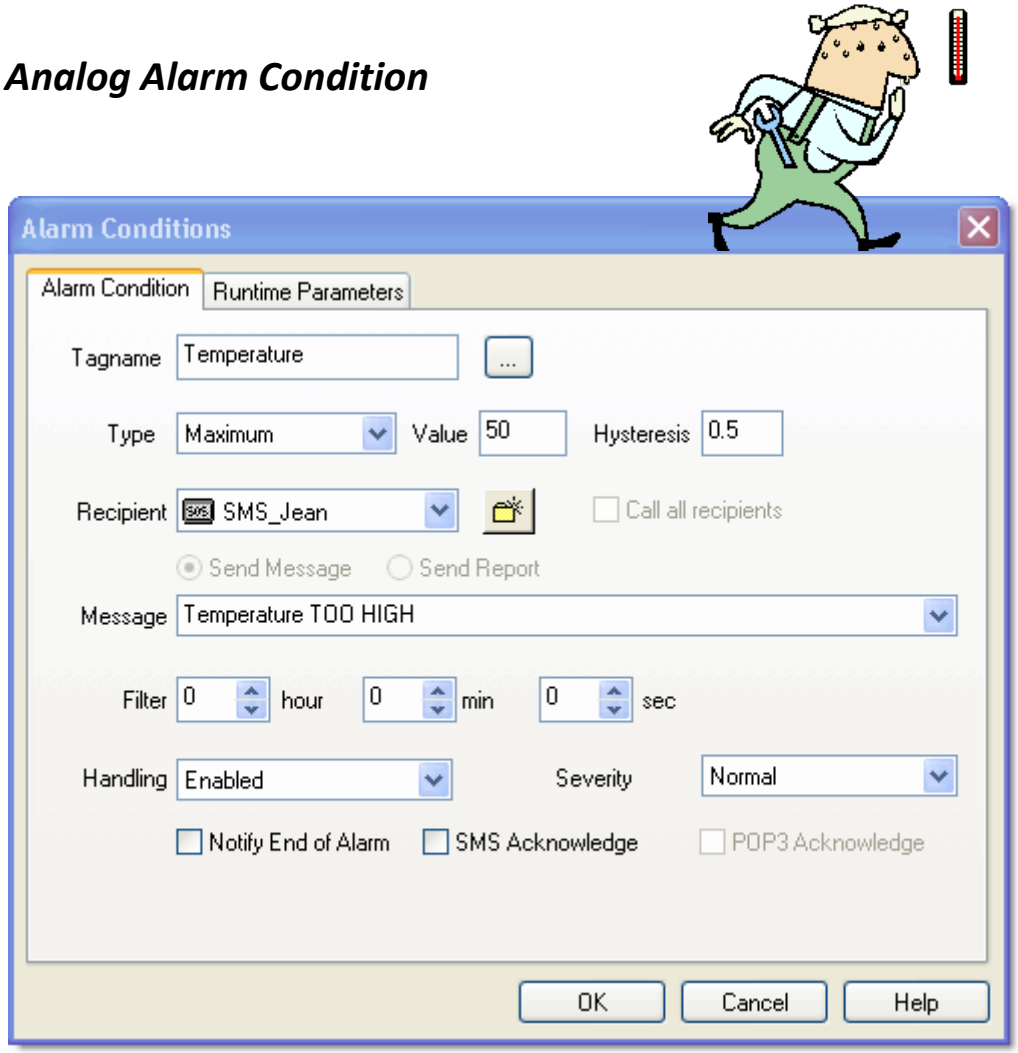
End of Alarm: When the alarm condition is finished, the alarm is automatically re-sent to the same recipient with the same message **preceded with a prefix** (see chapter 7.5.2).
Example: for a 'positive edge' alarm, it is when the Tag returns to '0'.

It is also useful when the alarm condition is active when ***TBox ULP*** starts up. When 'end of alarm' is checked, an alarm is automatically generated when the alarm condition disappears (see illustration chapter 11.8.: ***Alarms table***)

SMS acknowledge: See chapter 12.2.

POP3 acknowledge: See chapter 10.4.1

11.3. Analog Alarm Condition



Tagname: The Tag selected to generate the alarm.

Type: Maximum or Minimum.
The threshold for which the alarm will be started. If the value of the analog Tag passes under (minimum) or over (maximum) this threshold, the alarm is started. If an alarm must be generated for both a maximum and a minimum threshold, 2 conditions must be declared with the same Tag.

Value: The threshold value, according to the scaling defined when creating the Tag (see chapter 9. ***The Tags***).

Hysteresis: The amount that the level must fall or rise below or above the Max. or Min. value before an alarm can be re-started

Relation between Value and Hysteresis

With "MAXIMUM" threshold	Value > threshold = Alarm TRUE
	Value < (threshold – hysteresis) = Alarm FALSE

With "MINIMUM" threshold	Value < threshold = Alarm TRUE
	Value < (threshold + hysteresis) = Alarm FALSE

Recipient: Select a **Recipient** or a **group of recipients**. The 'person' you wish to contact in case of alarm (see 'Recipients' below).
In case you select a '**group of Recipients**' see next.

Call all Recipients: To be used when selecting a **Group of Recipients**.

When the option is cleared: ***TBox ULP*** calls the first one in the group. In case the alarm cannot be acknowledged after the number of tries, ***TBox ULP*** automatically calls the next recipient in the group and so on until it succeeds. Then it stops. (Also known as 'Chain')

When the option is checked: ***TBox ULP*** sends the alarm to all recipients of the group. (Also known as 'Link')

Message or Report: text or **file** associated to the alarm.

Depending on the recipient associated, it is the SMS sent to a GSM, or the message/report sent as e-mail or the text printed, or the file sent by FTP …

It also appears in the table of alarms, to distinguish them (see chapter 11.8.).

If the alarm condition sends an **e-mail**, it can be of 2 kinds:

Message: a text message is sent and it appears in the 'object' field of the e-mail

Report: sending of a report created with 'Report Studio'. The report can be created from the Project Workspace and the list of 'Web & Report files'.

Filter: The time in hour:minute:second during which the condition must stay TRUE, before the call is generated.

The availability of filter periods depends on the wake-up rate of the CPU. One cannot define a filter in "seconds" with a wake-up "each minute".

Filter can be tested either during both transitions or only during the transition selected (see chapter 7.5.2)

Handling: The handling option allows blocking each alarm condition, manually or automatically.

- Enabled: alarm condition always active.
- Disabled: alarm condition always de-activated.
- PowerF: alarm condition disabled when there is a main power failure.
- DisAla: alarm condition de-activated when the system variable 'DisAla' is at 1.

Severity: Each alarm can be assigned a level of severity: Low, Normal or High. When several alarms are still present in the queue and not processed yet, ***TBox ULP*** generates the calls according to the highest severity.

Alarm with a severity "high" will force power-up of the GSM at wake-up of ***TBox ULP*** and be proceeded immediately.

Other alarms will be proceeded at either:
- next power-up of GSM
- if variable Com2.ModemAlarm has been activated, it will force Power-up of GSM at wake-up of ***TBox ULP***

End of Alarm: When the alarm condition is finished, an alarm is automatically sent to the same recipient with the same message **preceded with a prefix** (see chapter 7.5.2).

Example: for a 'maximum' alarm, it is when the value returns below maximum - hysteresis.

It is also useful when the alarm condition is active when ***TBox ULP*** starts up. When 'end of alarm' is checked, an alarm is automatically generated when the condition of alarm disappears (see illustration chapter 11.8.: ***Alarms table***)

SMS acknowledge: See chapter 12.2.

POP3 acknowledge: See chapter 10.4.1

11.4. Recipients

To access the definition of Recipients, click the folder 'Alarms' in the Project workspace and select 'Recipients'.

The types of recipients supported are:

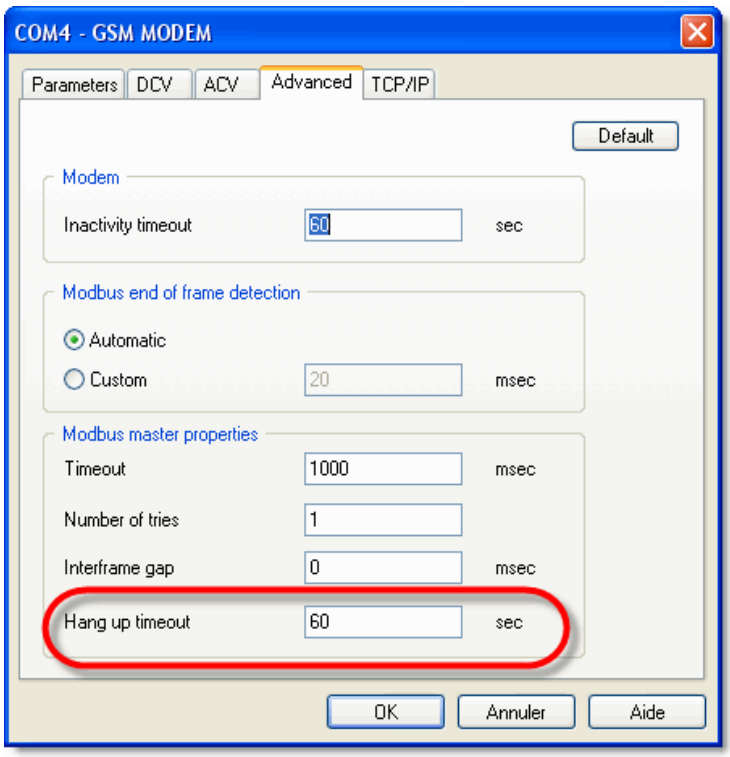
Internal: the alarm is saved in the stack of events and **no call is generated**.
It can be used to memorize a particular event without generating an alarm or to test an alarm condition.

ModBus: it can be Master or Slave.
It is used to establish a **ModBus connection** to another ModBus device or a SCADA (for instance Tview).
The difference between Master and Slave concerns the handling of the modem connection and acknowledgement.

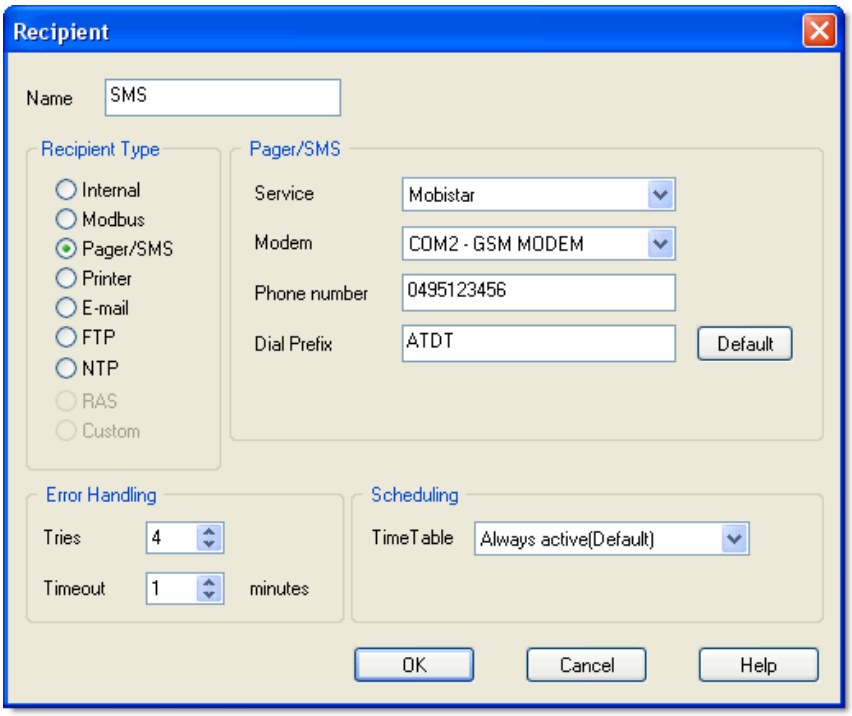
A 'Slave' connection means that ***TBox ULP*** dials an equipment and doesn't do anything else. The dialed equipment will sample, acknowledge and hang-up. Typically used for instance when dialing Tview .

A 'Master' connection means that ***TBox ULP*** dials a ModBus equipment and will also sample this equipment (with Remote Tags).
TBox ULP will then be also responsible of acknowledgment (see chapter 8.8.2 ***System Variables*** [8] AlaID or [10] AlaRec) and hanging-up (see 'Advanced' properties of the communication port used to send the alarm).

A modem parameter: "**Hang up timeout**" is used by 'ModBus-Master' alarm to define the maximum connection time. The maximum value is 600 seconds.

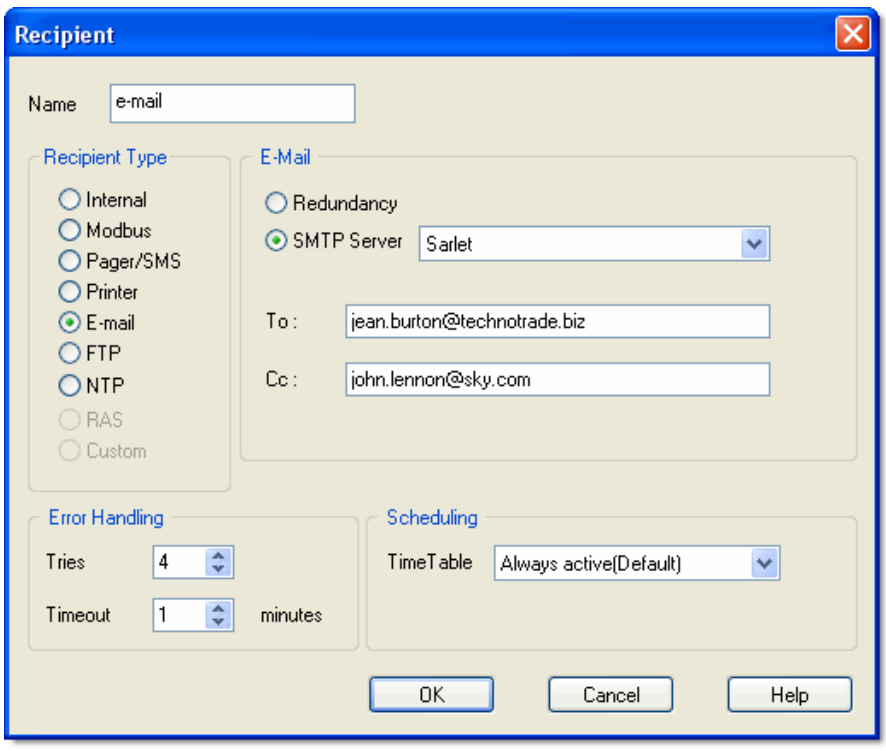


Pager/SMS: to send **SMS** to a mobile or message to a **Pager**.
Select the **Service** corresponding to the pager or mobile and a **Modem**.
Type the **Phone Number** of the Pager or Mobile.
The default **Dial prefix** is ATDT. **It should not be changed** unless the modem needs a particular configuration.



Printer: sending of message(s) or report to a local printer.

E-mail: If you have subscribed an e-mail account (see chapter 10.3. ***SMTP Server***), the ***TBox ULP*** is able to send an e-mail. You only have to specify the e-mail address of the recipient.

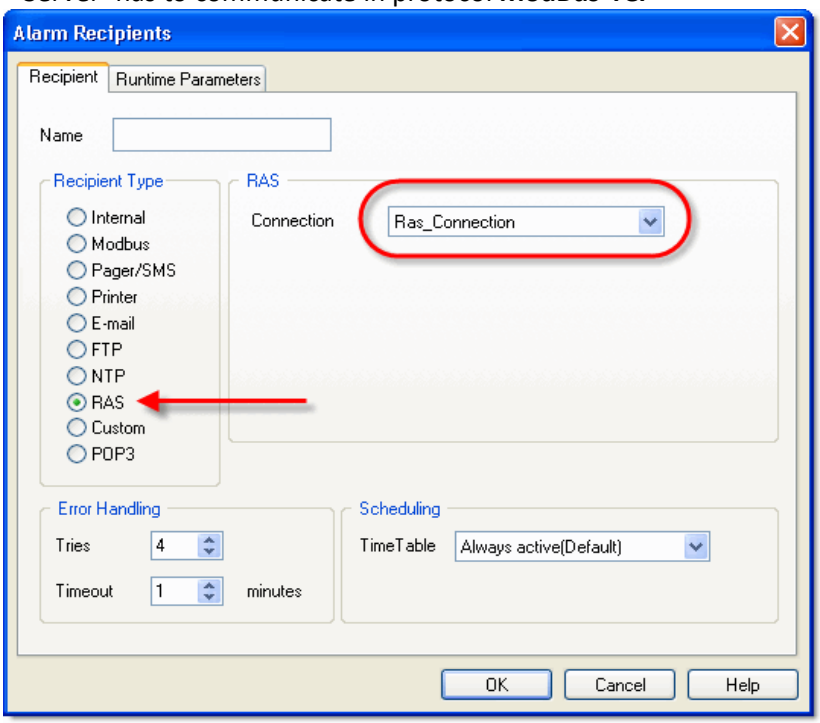


Sending of e-mail supports **Redundancy.**
If you have created **several SMTP Servers** and you select 'Redundancy' instead of a Server, ***TBox ULP*** will use the first one in the list (see chapter 10.3. ***SMTP Servers***). If it fails, it will try with the second one and so on…

FTP: ***TBox ULP*** is able to send files to a FTP Host (see chapter 10.2. ***FTP Host***).
In the recipient configuration you only need to indicate the directory where you want to send the files.

NTP: ***TBox ULP*** is able to synchronize its clock with an external NTP server.
In the recipient, you only select a server you have created in the list of NTP Servers (see chapter 10.5. ***NTP Server***).

RAS: This type of recipient can be used to establish a 'Client' modem connection to a 'Server'. The Server is considered by ***TBox ULP*** as an ISP: it requires a telephone number and a login to establish the connection. You associate an ISP (previously created in the IP parameters of TWinSoft), and when connection is established, the 'Server' has to communicate in protocol **ModBus-TCP**



It can be assimilated to a 'Modbus-Slave' connection using ModBus/TCP protocol. The Server is responsible of acknowledgment and hanging-up.

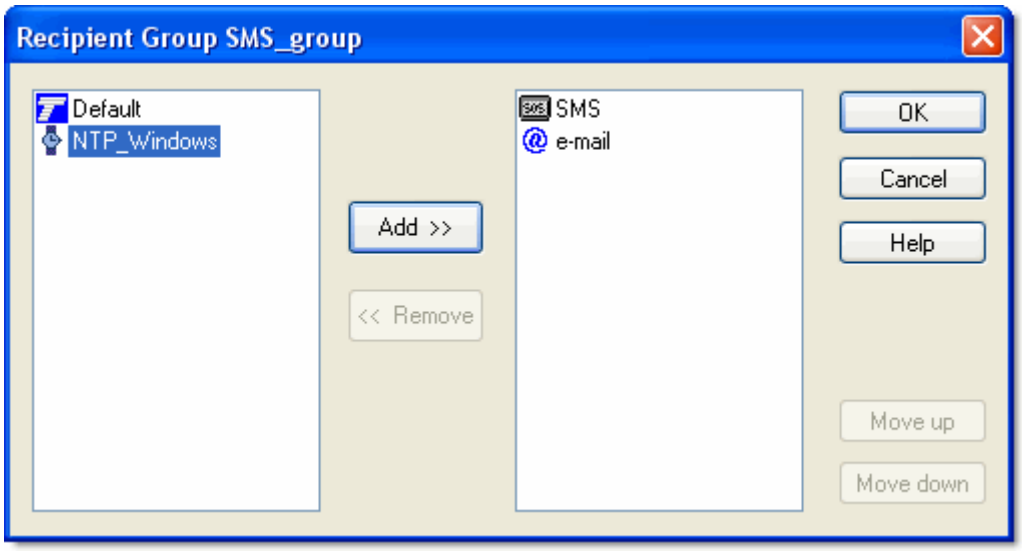
Custom: in case a 'C' driver allows sending alarms

POP3: allows reading e-mail to acknowledge e-mail or to operate TBox with a message (see details in chapter 10.4.1)

11.5. Group of Recipients

A group of recipients is composed of several recipients, which can be of different types (SMS, e-mail, …). You can declare several groups.

Then previous to creating groups of recipients, you have to create first the recipients (see above).



You can then associate an Alarm condition to a 'recipient' or a 'group of recipients'.

Working with groups of recipients offers 2 possibilities:

1. <u>You select the option 'Call all recipients':</u> the alarm is sent to **all recipients**, one after each other (→ equivalent to the '**Link**' with previous generation of RTU, the **TBox CPU-3**).
2. <u>You don't select the option 'Call all recipients':</u> the alarm is sent to the first one in the list; if it fails, to the second one; if it fails to the third one ; …
   When it succeeds the sending process stops.
   (→ equivalent to the '**Chain**' with previous generation of RTU, the **TBox CPU-3**).

11.6. Messages

To access the definition of Alarm messages, click the folder 'Alarms' in the Project workspace and select 'Messages'.

Message number : it indicates the index of the message, corresponding to its position in the list of messages.
Type a message of maximum 120 characters.
This message is user specific:
- If it is for a Digital Pager, it will consist only of numbers.
- If it is for a Text Pager or for a GSM, it will not contain accent (ü, é, à, ...)

11.6.1. Value of Tag in a message

Two kinds of value are available:

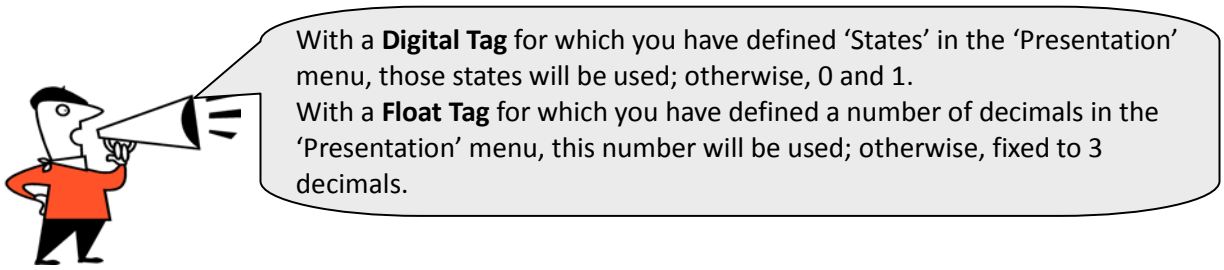
The value at the moment the alarm is sent

The value will be the value of the Tag **at the moment the alarm is accessed**: the SMS is sent, the alarm list is displayed in a WebForm, the alarms retrieved from TView, ...
The syntax is: **~TAG~** (with TAG=the name of the Tag).

The value at the moment the alarm appeared

The value will be **frozen** to the one at the moment the alarm is stored in the stack of events.
The syntax is: **TAG** (with TAG=the name of the Tag).

Remarks:
1. Tag TEXT cannot be used in a message with Tag. No problem with ~Tag~.
2. With -WM, -MS16 and -LITE: ONE **Tag** can be inserted in a message. No limit with ~Tag~
3. With -MS32: TWO **Tag** can be inserted in a message. No limit with ~Tag~


With a **Digital Tag** for which you have defined 'States' in the 'Presentation' menu, those states will be used; otherwise, 0 and 1.
With a **Float Tag** for which you have defined a number of decimals in the 'Presentation' menu, this number will be used; otherwise, fixed to 3 decimals.

11.6.2. "String" in a message

Possibility to include a series of ASCII characters in one alarm message.
Put the character hyphen " - " in front of the TAG.
Syntax like follows:

I say **~-TAG~** to everybody

~-TAG~ will be replaced by characters corresponding to ASCII code, starting at Tag "TAG". It ends when code **0x00** is encountered or after 32 characters.

Example
with the following value at TAG and following:

TAG :	0x48	(H)
TAG+1:	0x45	(E)
TAG+2:	0x4C	(L)
TAG+3:	0x4C	(L)
TAG+4:	0x4F	(O)
TAG+5:	0x00	

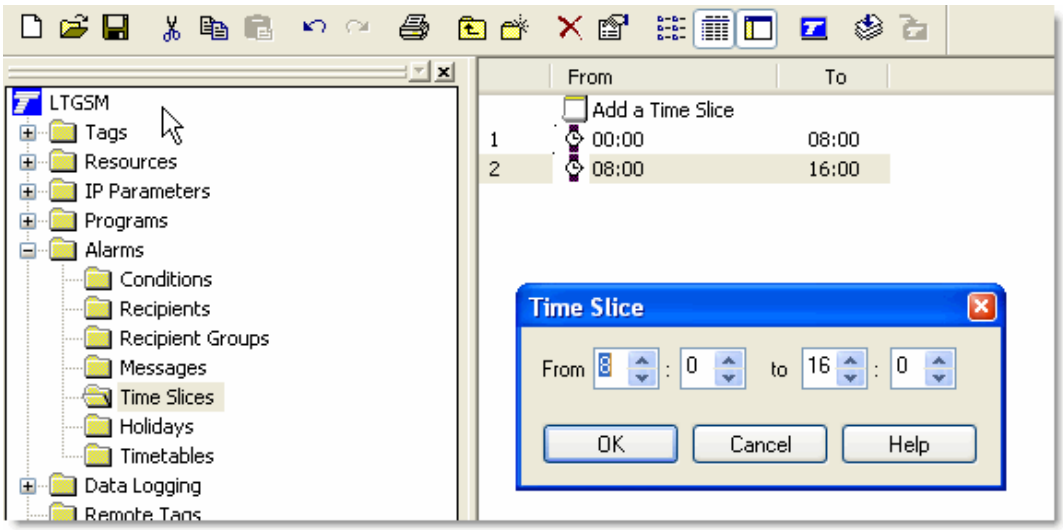
The following message will be generated: **I say HELLO to everybody**

11.7. Alarm Timetables

Alarm timetables allows specifying an activity period associated to a recipient, in other words, periods of time during the day, the week, the year, when a recipient can receive an alarm.
The time tables are based on the specification of 'Time Slices' (time periods of the day) and on 'Days' (days of the week and holidays).

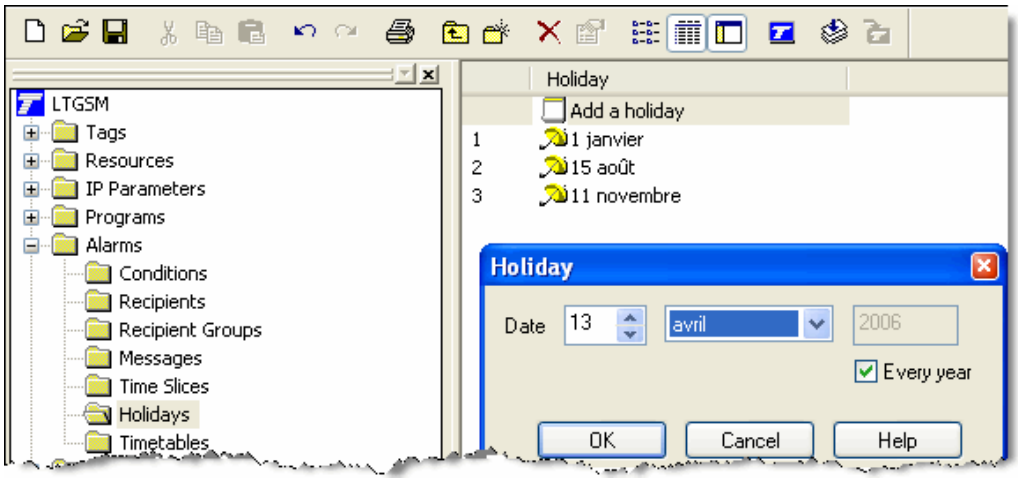
11.7.1. Time Slices

The time slices are used to trunk the day in different slices. Further, you select those time slices when creating timetables.
To declare the time slice, just select the start time and the end time of the slice.
A time slice **can't be part of 2 different days**: no time slice can include midnight! (e.g. 18h30 to 08h30)



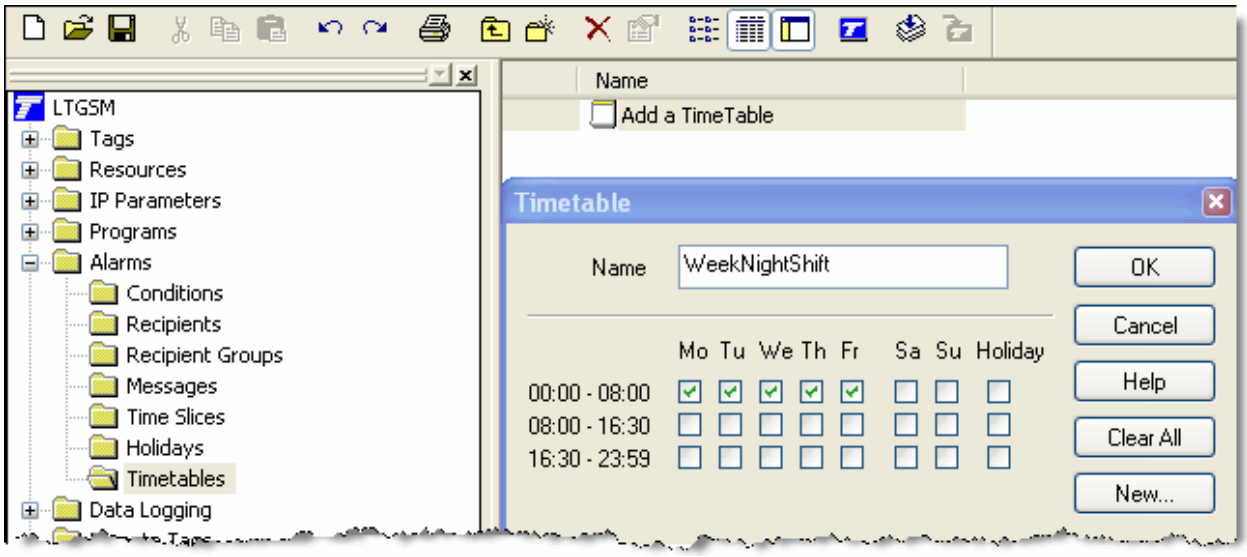
11.7.2. Holidays

The holidays offer to flag specific days of the year; these days constitute a group that can be checked in the timetables (all at once, not days separately) like if it was a specific day of the week (see Time Tables next).
You can choose to keep each selected day as holiday for 'every year' (by default).

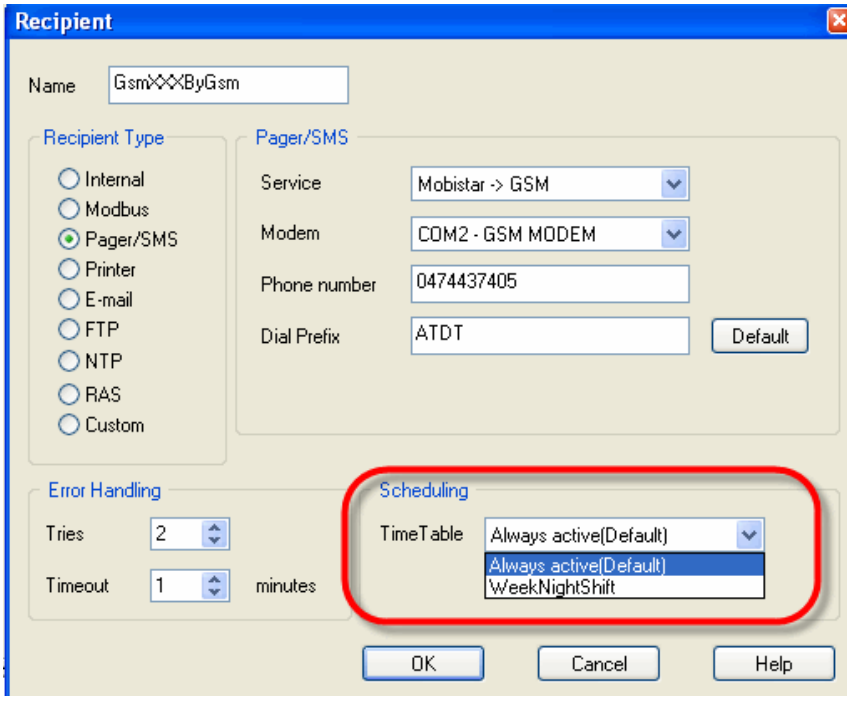


11.7.3. Timetables

Based on the 'Time Slice', days of the week and 'Holidays' you create different 'Timetables' according to activity periods in your company (day shift, night shift, holidays, week-end, …). A time table can then be associated to a recipient.
You select for each days of the week which time slice will be part of the timetable (Holidays being treated like a unique 'day').



Following, in the recipients' setting, you can choose to have the recipient 'always active' which means that he will receive his alarms any time of the day, or you can also choose to have the recipient active only during a particular timetable (e.g. Day shift without week-end and holidays).



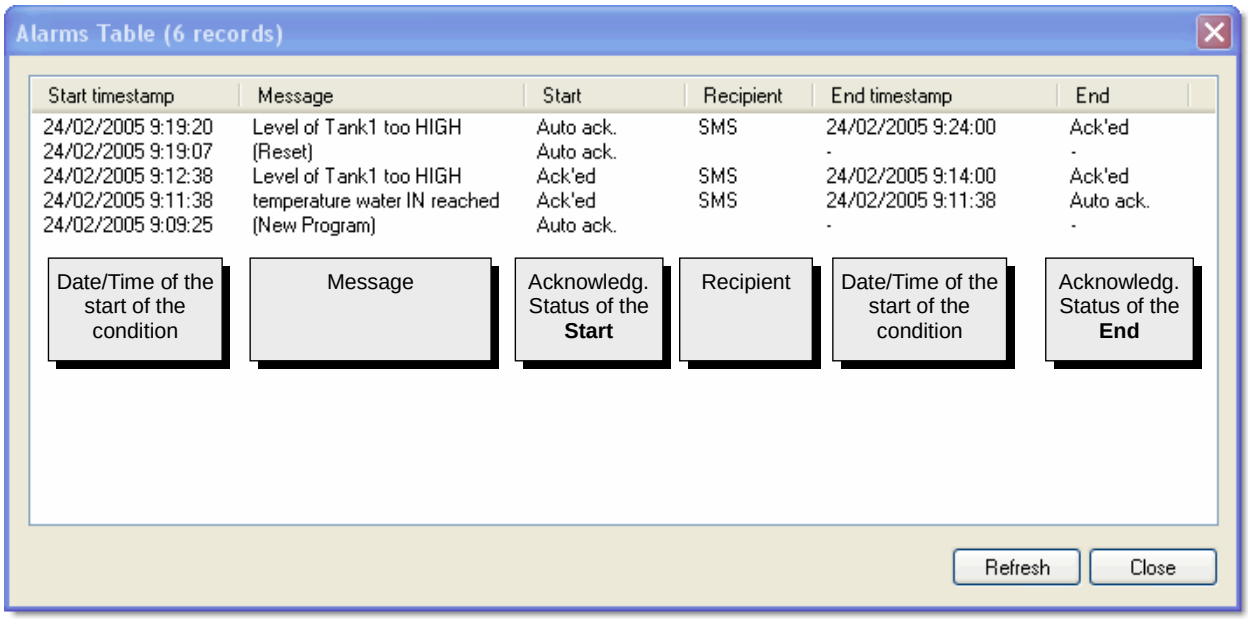
If an alarm occurs when time table is active, the alarm will be sent. Otherwise, the alarm is automatically 'auto ack.' as you can read in the 'Alarm Table' (See here under).

11.8. Alarms table

The Alarms table displays the **Events stack** of ***TBox ULP***.

The Events stack is the visible part of the handling of some system events and alarms in ***TBox ULP***.
The internal queue of alarms is not accessible.

You access the Alarms table from the main menu: Communication → Download → Alarms



The Alarms table does not only display alarms generated in ***TBox ULP***, but also **system events** like start-up of the program, Reset of the ***TBox ULP***, …

11.8.1. Columns description

Start Timestamp: Date and time when the **alarm condition appears** ('Start' condition)

Message: Message (or name of the file) associated with the alarm.
System events appear between brackets.

Start: acknowledgment status of the 'Start' condition.
The possibilities are:

- Not ack.: the alarm is still in process.
- Ack'ed: the alarm has been processed successfully.
- Auto ack.: the alarm has not been processed successfully.
  In case of 'system events', it is always the case as it is not an alarm but an event.

Recipient: The name of the Recipient (from the list of Recipients).
The name is listed only if the alarm was sent successfully. With chained alarms, this allows to show the one that was used.
In case of 'system events', there is no name.

End Timestamp: Date and Time when the **alarm condition disappears** ('End' condition).

End: acknowledgment status of the 'End' condition.
When creating an alarm condition, there is an option '**Notify end of alarm**'. This option will automatically generate an alarm when the condition generating the alarm disappears.
The possibilities are:

- Not ack.: there is a 'Notify end of alarm' condition and the alarm is still in process.
- Ack'ed: the 'end of alarm' has been processed successfully.
- Auto ack.: the 'end of alarm' has not been processed successfully.
  When there is **no 'end of alarm'**, it is immediately indicated as 'Auto ack.'

12. Read SMS embedded

12.1. Introduction

ReadSMS/POP3 is the capability of the RTU to receive and interpret incoming SMS messages, and to read “subject' of e-mail to execute tasks.

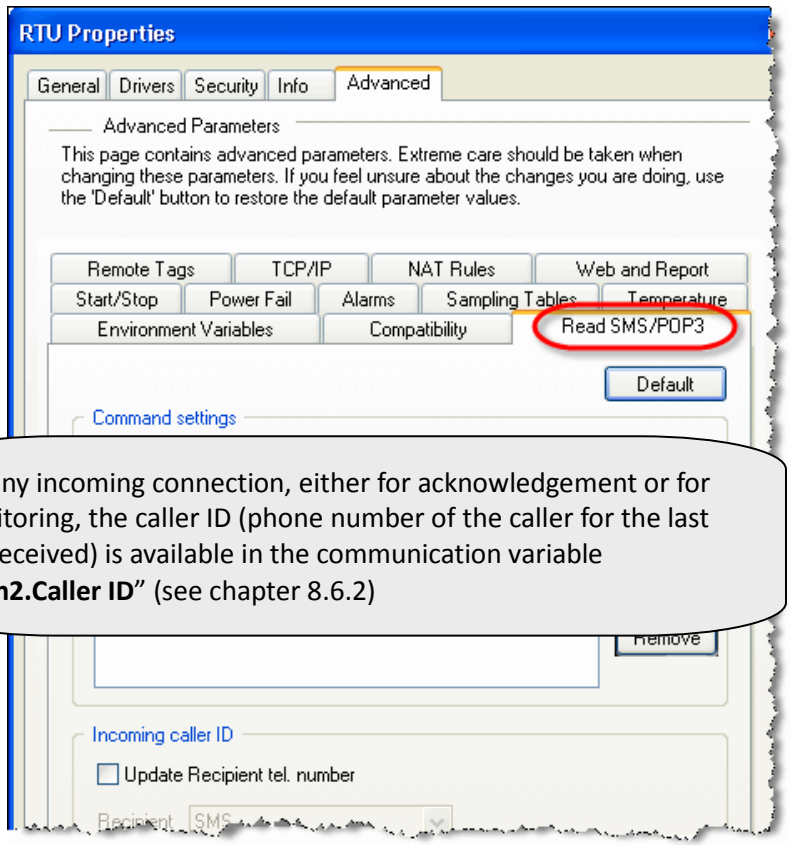
The GSM must be **powered** to access the SIM card and its SMS messages. Working in GPRS, when it is in idle mode, SMS can be sent and received.

When an incoming SMS is detected, it is monitored independently from the wake-up of the CPU. But the control of the message(s) will be done at wake-up.

This feature allows two uses:

1. **Acknowledgment** of an alarm by sending back a SMS to the RTU
2. **Controlling** the RTU by sending SMS message(s) or sending e-mail(s)

An advanced menu is available in the RTU properties:



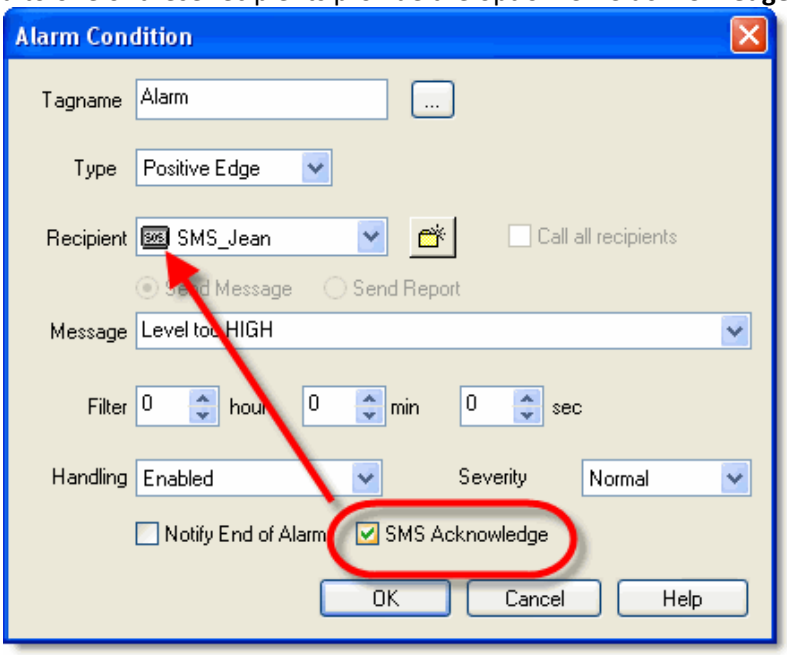
For any incoming connection, either for acknowledgement or for monitoring, the caller ID (phone number of the caller for the last call received) is available in the communication variable “**Com2.Caller ID**” (see chapter 8.6.2)

12.2. Acknowledgment of an alarm by sending SMS to the RTU

Two types of recipient may require an acknowledgment by SMS:

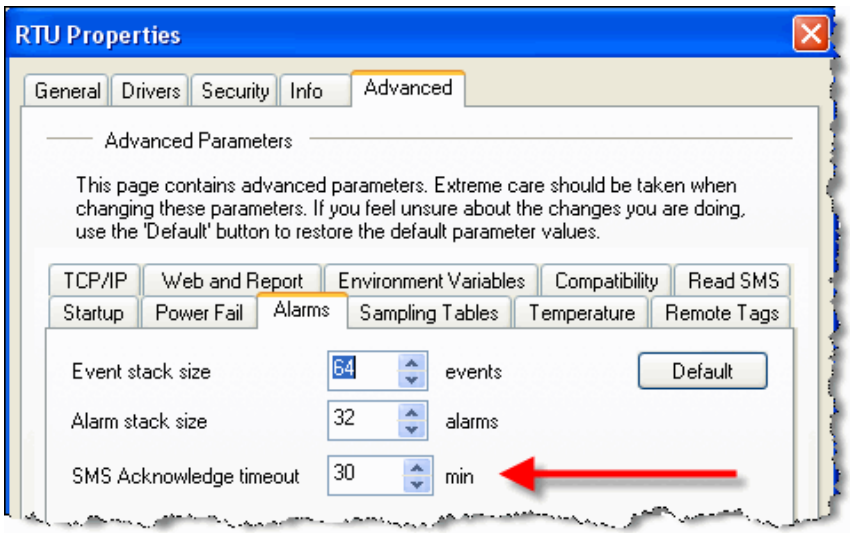
- Pager/SMS: sending a message through a SMS-C (standard way)
- E-mail: sending a message, which can be forwarded as SMS through a dedicated service

Alarm conditions associated to one of these recipients provide the option: **SMS acknowledge**



acknowledgment will be executed in 2 steps:

1. The sending of the message by the ***TBox ULP*** (to the SMS-C or to the e-mail provider) will be first performed. Retries and time-out defined in the recipient will be used to determine the success or failure of this first step.
2. Then a second time-out, defined in the advanced 'Alarms' properties, will check if the incoming SMS required to acknowledge the alarm, arrives on time.



The incoming SMS must arrive within this time-out for the alarm to be acknowledged. If not, a retry will be executed according to the definition in the Recipient. After the end of retries, the alarm will be considered as in error: "auto-ack" and the system variable 'AlaErr=1'.

Working with 'Group of Recipients':

- with option ‘Call all recipients’: all recipients have to acknowledge the alarm.
- without option ‘Call all recipients’: any recipient can acknowledge the alarm.

Don’t set a time-out too short, to give time to the SMS Center to send the SMS back to the CPU, in case the service is busy. Also, if the CPU sends an SMS while acknowledgment SMS is coming in, it will miss the warning from the GSM, the SMS will be stored in the SIM card and will have to wait until the next auto-check from the CPU (max. 5 minutes).

12.2.1. Structure of the message

If the option ‘SMS acknowledge’ has been selected, the RTU will send a header with the message including an identification number.

Example: **`#A00056# Level too HIGH`**

#	prefix (fixed).
A	precedes the absolute identification number of the alarm.
00056	absolute identification number of the alarm.
#	suffix (fixed).
message	message associated to the alarm.

12.2.2. Acknowledgment of the message

By sending to **the same header syntax** to the RTU, you will acknowledge this specific alarm. Typically, this can be done using the option ‘Reply’ of the mobile. Verify that your mobile also sends the original message.

Example:
```
#A00056# Level too HIGH
      Reply: YES
```

The text sent to the RTU does not matter, as long as the syntax **#Axxxxx#** is sent.

Some variables are very useful to monitor the acknowledgment of the alarms by SMS: AlaErr, SmsState, CallerID (see chapters 8.6. and 8.8.)

12.3. Controlling the RTU using SMS message or reading e-mail using POP3

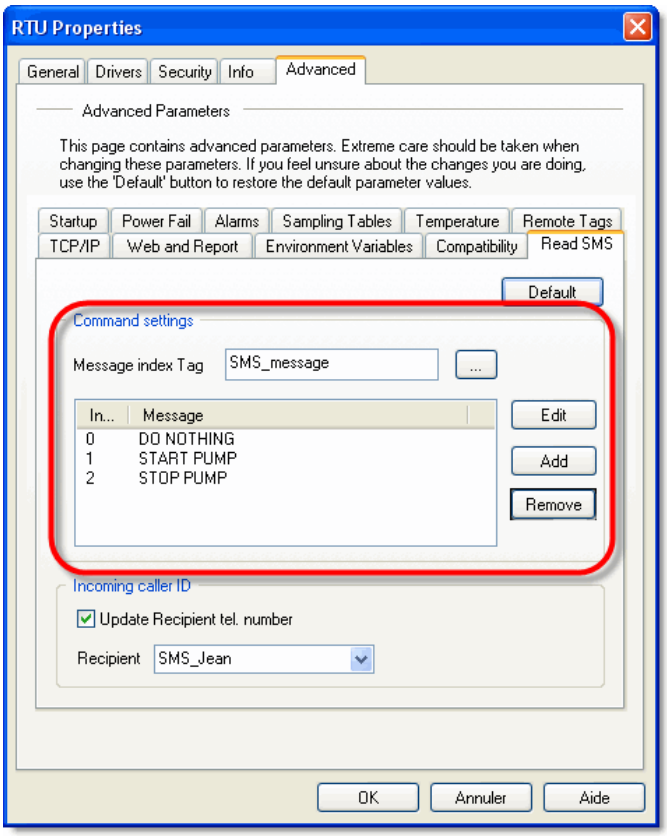
ReadSMS/POP3 provides the possibility to **control the RTU** by sending predefined SMS or by reading e-mail, meant to ***TBox ULP***, using POP3 service.

Details of the different possibilities:

1. Using pre-defined messages (-)

- From the ReadSMS properties menu, you select a '**Message index Tag**' (analog Tag - 16 bits format), that will contain a value associated to the message sent to the RTU
- You add the message(s) you intend to send to the RTU

When the RTU receives the message, it will put the corresponding value to the 'Message index Tag'



Notes:
- SMS/POP3 message are not case sensitive
- This method of monitoring, using message, **is the only method supported by POP3**.

Message sent by SMS

A message can combine one or several data: Password, acknowledgment ID, writing values directly to ModBus addresses,...
It must always start and end with the character **#**

Examples:

```
#-START PUMP#
#P1568,A00056,-START PUMP,W20480=123#
```

The maximum number of messages supported is 20. In case you need to monitor more process, you can use the direct/indirect addressing (see next).

Message sent by e-mail

A message **must include the RTU Id** of the ***TBox ULP*** , preceded by the letter **I** and a pre-defined message. It may also include an acknowledgment ID.
It must always start and end with the character **#**

Examples:

```
#I460000020107,-START PUMP#
#I460000020107,A00002,-START PUMP#
```

2. Writing Tag with Direct addressing (W)
You write a value directly to a ModBus address.

Syntax: **#Wmodbus address=value#**

Example: **#W20480=123#**
This message sent to the RTU will write value 123 to the analog Tag with ModBus address 20480

Notes:

1. You can combine several texts, separated by a comma. For instance:
   #W20480=123,W20481=456#
2. ReadSMS checks access protection level of the port before writing (see point 5. below)

3. Writing Tag with Indirect addressing – analog (N)
You write a value directly to a ModBus address representing a pointer.

Syntax: **#Nmodbus address=value#**
The value at 'modbus address' corresponds to the ModBus address to write in.

Example: **#N20480=123#**
If ModBus address 20480 contains the value 1000, the value 123 will be written to the ModBus address 1000.

We make a distinction between Target address corresponding to an analog Tag and a digital Tag (see next).
With indirect addressing, ReadSMS **does no check the access protection** level of the GSM port

4. Writing Tag with Indirect addressing - digital (D)
You write a value directly to a ModBus address representing a pointer.

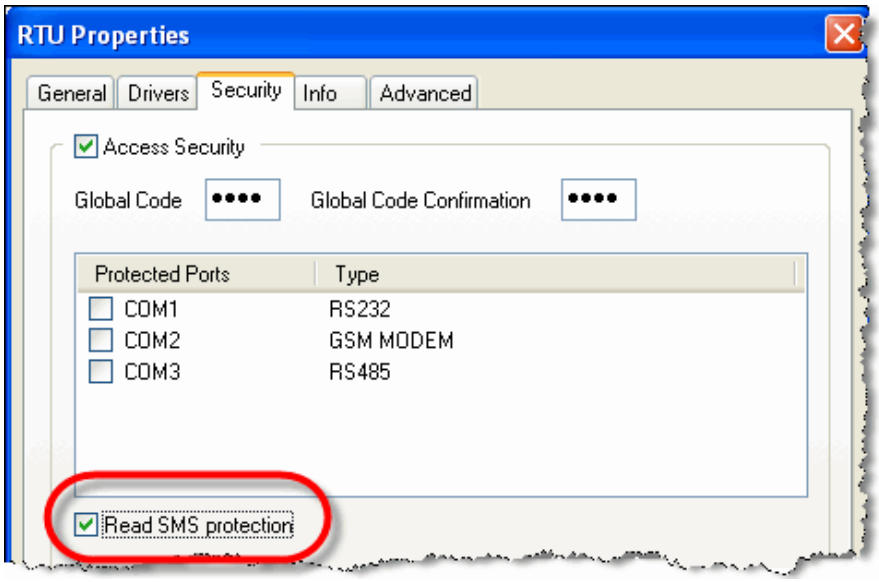
Syntax: **#Dmodbus address=value#**
The value at 'modbus address' corresponds to the ModBus address to write in.

Example: **#D20481=1#**
If ModBus address 20481 contains the value 512, the value 1 will be written to the ModBus address 512.

5. Access protection (P)

ReadSMS access protection **is independent from the GSM port it is associated to**. In other words, even if the communication port is protected, ReadSMS will not specially be protected.

ReadSMS has its own independent access protection configuration, that can be activated from:
RTU properties
→ Security.



If ReadSMS protection is activated, a **login is required** in the incoming the SMS message.
The login is composed of **the last 8 digits** of telephone number of the mobile used to send the SMS and a **password**.

To obtain the Password, the utility 'Password Generator' is needed (Start → Programs → Techno Trade → Accessories → Password generator).

From the Password utility, you define:
- the global code used in the RTU
- as NAME: the last 8 numbers of the telephone number of the mobile which will be used to send the SMS.
- as Access Level: Engineer (Level 3).

The resulting '**PASSWORD**' must be used to login.

Syntax: **#Ppassword#**

Example: **#P1568#**

If needed, the Password **must be declared first.**
Acknowledgment (with code A) does not require password

6. acknowledgment (A)

See chapter 12.2 above

7. SET a digital Tag (S)
You write 1 to a digital Tag using its ModBus address.

Syntax: **#Smodbus address#**

Example: #S32#
The digital Tag at ModBus address 32 will be set to 1.

Note: ReadSMS checks access protection level of the port before writing (see point 5. above)

8. RESET a digital Tag (R)

You write 0 to a digital Tag using its ModBus address.

Syntax: **#Rmodbus address#**

Example: #R32#
The digital Tag at ModBus address 32 will be reset to 0.

Note: ReadSMS checks access protection level of the port before writing (see point 5. above)

9. Changing a telephone number (T)
You change the telephone number of a recipient using its index number (see list of recipients in TWinSoft).

Syntax: **#Tindex=telephone number#**

Example: #T05=0123456789#
You replace the telephone number of recipient 5 with 0123456789.

Notes:
1. Maximum length: 21 characters.
2. ReadSMS checks the access protection level of the port before writing (see point 5. above)

10. Writing minutes since midnight into a register (h)
To write in an analog register, the current number of minutes since midnight **at the moment the message is received**.

Syntax: **#Wmodbus address=h#**

Example: #W20482=h#
If the message is received at 15:23, the value 923 will be written at ModBus address 20482

Note: ReadSMS checks the access protection level of the port before writing (see point 5. above)

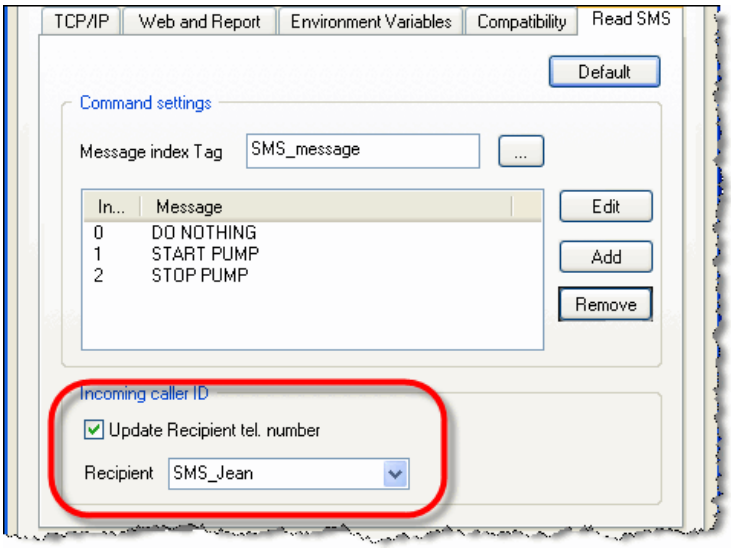
12.4. Automatic Update of a Recipient's tel. number

An **existing recipient** of type 'Pager/SMS' can be **updated** with the **telephone number of the person calling the RTU**.

The idea is that the RTU verifies the message it receives (using the ReadSMS special register status - see next) and is able to send back a message to the originator.

ReadSMS uses the caller ID of the originator to update the recipient you select in this menu, with originator's telephone number.

From the Process, you can then decide to send back an SMS, to confirm the order, to indicate the incoming message was invalid, that the password was incorrect, …

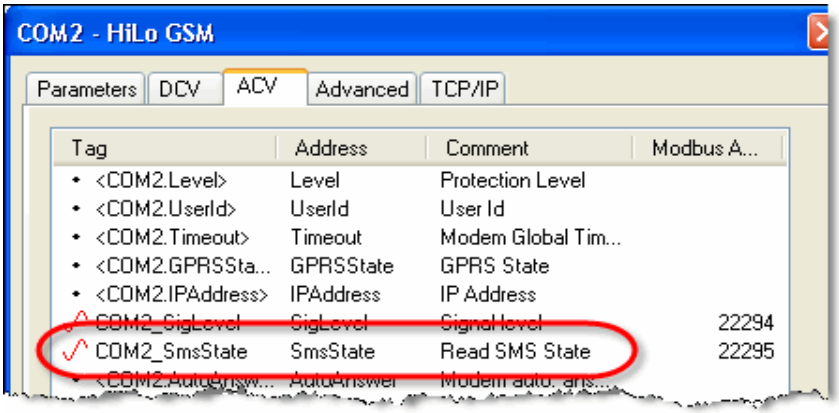


If this option is activated, the selected recipient will be automatically updated with the telephone number of **any incoming call** (if caller ID of originator has been activated!).

12.5. ReadSMS status

A communication variable, associated to the GSM can be used to check the status of ReadSMS.

From the GSM Com port, go to the tab 'ACV' and make a Tag of '**SmsState**'



Value	Description
1	Accepted message received
2	Acknowledgment received
10	Invalid message
11	Unknown command
12	Equality character (=) not found or incorrect
20	Incorrect password
21	Incorrect password or not supplied for a com. Port protected
30	Message received does not match a predefined message
31	Writing to an unknown address
32	Writing to an unknown address, using indirect addr. (address contained in the Tag not known)
33	Changing the telephone number of an unknown recipient

13. Datalogging

13.1. Introduction

Datalogging allows **memorizing values of your process**, in order to trace its history.

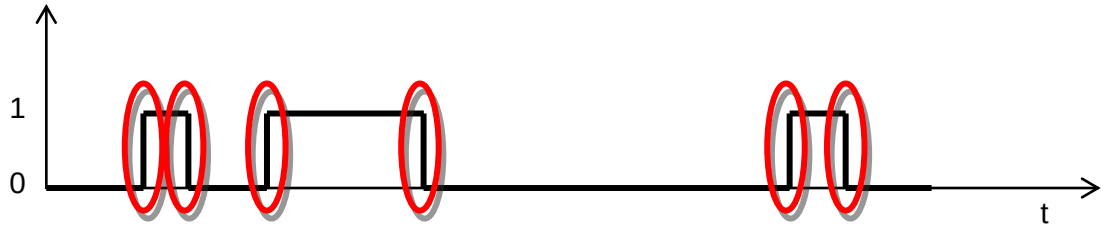
TBox ULP contains memory for recording historical values of Tags and events (see technical specifications); the latter is what we call the **database** of ***TBox ULP***.

There are two categories of databases:

The Chronologies

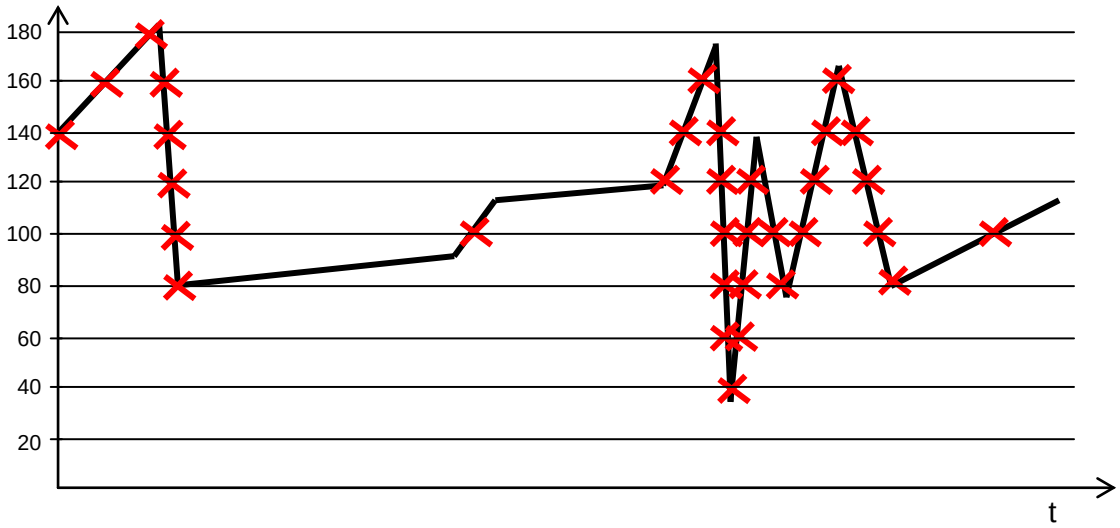
Chronologies are '**On event**' recordings, by means of changes in Tags (also known as "Sequence of Events"). Each event is recorded with the time, date, Tag and its status or value.

Example of 'digital event':



The changes of status of the Tag represent the events.

Example of 'analog events':



The variations of the Tag represent the events.

TBox ULP stores chronologies in 2 tables: one for digital events and one for analog events.
The size of the tables is defined in the ***General RTU properties***, as described chapter 7.1.

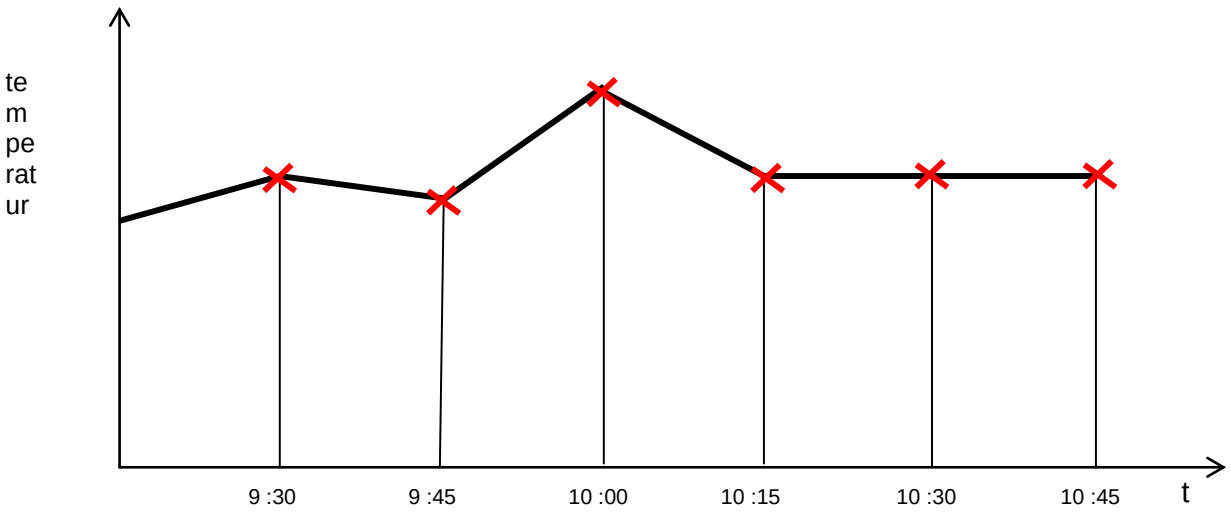
Recording into **chronologies** happens '**on event**', when the system is awake. The resolution of timestamp depends then on the wake-up period, with a minimum resolution of **1 second**.

The Sampling Tables.

Sampling tables use '**Periodical**' recording, with a minimum period depending on the wake-up period of the CPU (see chapter 7.1. ***General RTU Properties***).
Recording in Sampling tables happens at fixed intervals and does not depend on signal variations; it uses the clock of the CPU to determine the recording.

Only date and time of the last recording are stored. This mechanism requires less memory than chronology does.

Example of 'periodic recording':



Each Tag is recorded into a separate table. There is no practical limit in the number of tables, but the size of each table is limited.

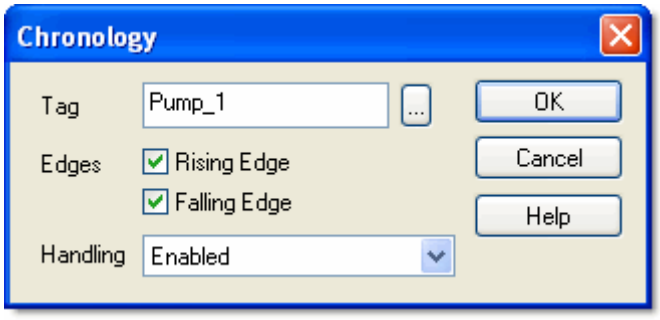
The database information recorded in ***TBox ULP*** can be retrieved with the use of SCADA software such as *Tview* or other HMI package with 'TComm.dll' based driver (please call your distributor).

By doing a compilation you can check **the space of memory available** (see chapter 5.9.2).

13.2. The chronologies

13.2.1. Digital chronologies

Example of an entry in Digital chronology: **Recording of the starting and stopping of a 'Pump_1'.**



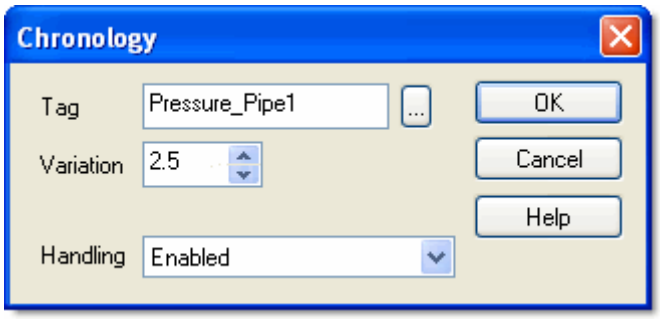
Edges: Recording on positive and (or) negative edge.

Handling:

- Enabled: always recorded.
- Disabled: never recorded.
- PowerF: recording disabled in case of 'main' power failure.
- DisCRD: recording disabled when the system variable 'DisCRD' is at 1.

13.2.2. Analog chronologies

Example of an entry in Analog chronology: **Recording of a variation of 2.5 bars in 'Pressure_Pipe1' input.**

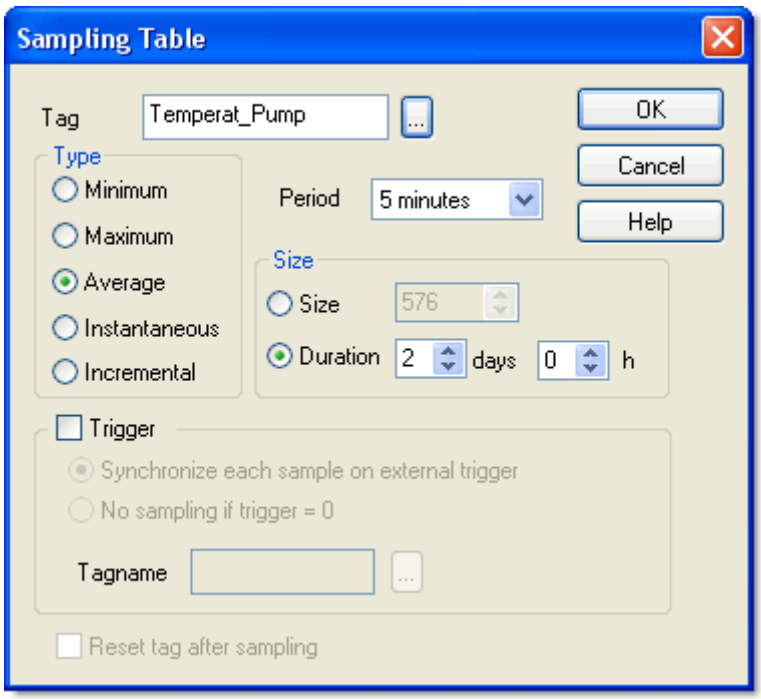


Variation: Recording in case of variation (higher or lower) in comparison with the previous recording. The unit is expressed according to the format selected in the Tag definition (see chapter 9.2.2: ***Analog Tags***).

Handling:

- Enabled: always recorded.
- Disabled: never recorded.
- PowerF: recording disabled in case of 'main' power failure.
- DisCRA: recording disabled when the system variable 'DisCRA' is at 1.

13.3. The sampling tables



Type: ***TBox ULP*** is able to execute calculations on a minimum time base depending on the wake-up rate of the CPU and **with a minimum resolution of 1 second**. The result of the calculation is written in the sampling table after the period selected (see next).
This value can be:

- Minimum : minimum value during the period.
- Maximum : maximum value during the period.
- Average : arithmetic average value calculated during the period. For each period a new average is calculated.

Tag format	Limitation in recording
8 bits	All periods accepted
16 bits	Period limited to 12 hours
32 bits	Not available
Float	All periods accepted

- Instantaneous : value at the moment of the recording.
- Incremental : ***TBox ULP*** records the difference between the current value and previously recorded value.

Example of incremental recording:

Value of the Tag	865	878	902	905	965	985
Incremental value recorded	…	13	24	3	60	20
	← Period →	← Period →	← Period →	← Period →	← Period →	← Period →

Period: Period between 2 recordings, depending on the wake-up rate of the CPU (see chapter 7.1. ***General RTU properties***).
You may choose between:
1sec; 2sec; 4sec; 5sec; 10sec; 15sec; 30sec; 1min; 2min; 4min; 5min; 10min; 15min; 30min; 1h; 2h; 4h; 6h; 12h; 24h; 48h; daily; weekly; monthly.
The recording happens at 'birthday' time of the period selected.

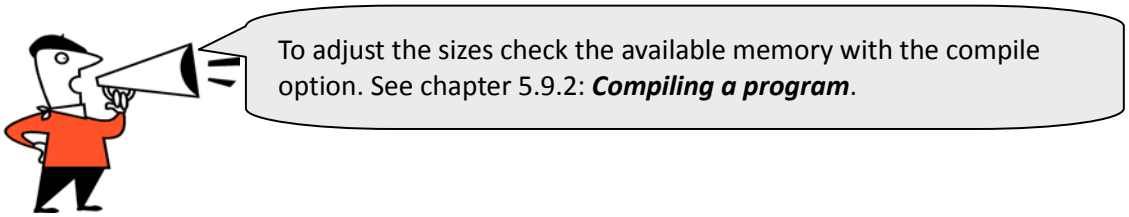
Example: if you select as period *5 minutes*, the recording will be done at:
9:25:00; 9:30:00; 9:35:00; 9:40:00 ...

In case you wish to make recording every day, or even with a longer period, the options are:

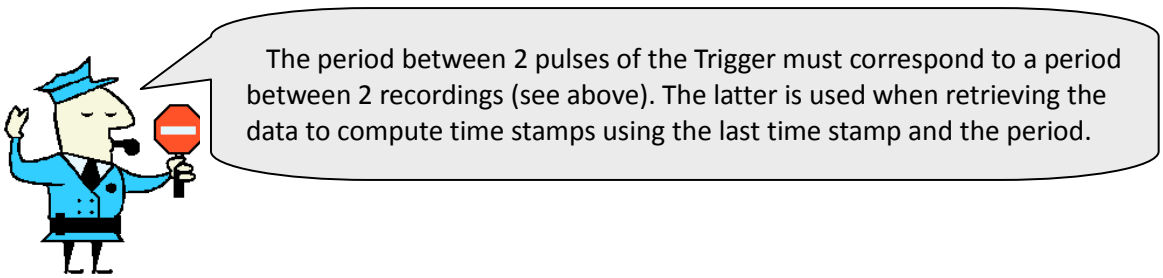
- daily: recording once a day
- weekly: recording once a week
- monthly: recording once per month.

The hour of the day, the day of the week and/or the month are defined once for all sampling tables in the RTU Advanced properties (see chapter 7.5.4.)

Size: The size can be expressed on two ways:
Size: the number of records of the table.
The recording works on the FIFO principle. According to the size, the duration is updated automatically (see next).
The size can be of maximum 65 535 records, with a total of 72 kbytes for datalogging.
Duration : you may prefer to enter a number of days and hours, in this case the size is automatically updated.



Trigger:
Synchronize each sample on external clock: the recording of the value is executed on the positive edge of the Tag selected, and **not with the clock of the CPU**.


The period between 2 pulses of the Trigger must correspond to a period between 2 recordings (see above). The latter is used when retrieving the data to compute time stamps using the last time stamp and the period.

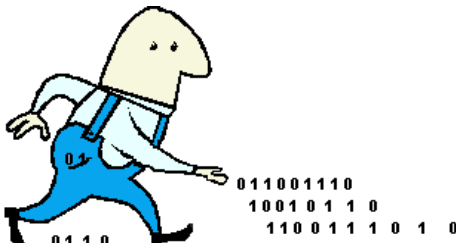
Example of use of external Trigger: quarter - hour management.

In some industries, every 15 minutes (may vary slightly), your electric company sends a pulse which is used to calculate the consumption, based on average consumption during 15 minutes. You will be charged based on the **highest consumption.**
In order to analyse your consumption and prevent from peaks, you can use this pulse as Trigger.
Recording will be done each time the pulse arrives, but when **retrieving data**, the calculation of timestamp will be computed from the time stamp of the last recording and the period.
This means it can only be used if the period between pulses corresponds to a period between 2 recordings (see above).

No sampling if trigger = 0: the CPU clock is used to record data (see period above), but the recording is only possible when the Tag Trigger is in "high state". When it is negative, the recording stops. **On the positive edge of the Tag, the table is erased and a new recording starts**.

Reset Tag after sampling: if this option is checked, the RTU automatically resets the register that has been recorded.
This option works only with registers, NOT I/O !

14. Remote Tags



14.1. Introduction

Remote Tags allow exchanging information between two or more ModBus stations via any communication ports.

Typically, it is a ***TBox ULP*** connected to a local ModBus device through RS485.

One often speaks of 'Master Network' because it is a Master/Slave communication: the **Master executes reading and writing in slave(s)**.
TBox ULP, being 'Master', reads and writes the variables with all other devices using the ModBus protocol

Each Remote Tag corresponds to **one transaction** (reading or writing) with 1 slave.

When there are several stations, ***TBox ULP*** executes the different transactions of one station at a time, then transactions of the following station, and so on …

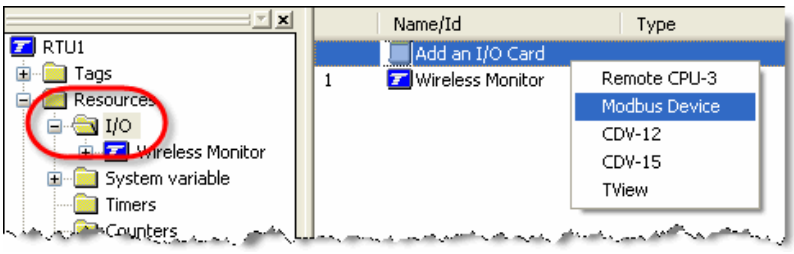
Before creating a Remote Tag you have to create the equipment you are going to communicate with.

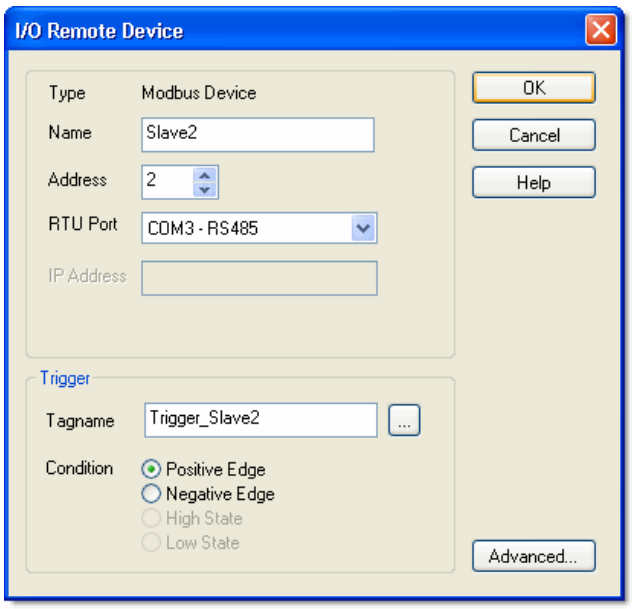
Communication consumes energy; 1.5 mA at 9600 bps !
Try to reduce communication as much as possible.
Communication is monitored by a "Trigger". The frequency this trigger can be activated will depend on the wake-up rate of the CPU

14.2. Creating a Remote Device

From the Project Workspace, select 'Resources' → 'I/O'. Click 'I/O' and in the list of I/O, click 'Add an I/O card'.

ModBus device: any device supporting ModBus-RTU





Name: You type any name. It will be available in a list of available equipment when creating 'Remote Tags' (see next).

Address: It is the ModBus address of the Remote equipment. **It must be different from the *TBox ULP* and possible other equipment on the same network**.

RTU Port: The communication port used by ***TBox ULP*** to communicate with the remote equipment.

Trigger: Select a digital Tag that will trigger the communication, according to a 'Condition' (see next). Working with several equipment, you can declare different Tags and then monitor differently the communication to each equipment.
The Trigger must be a digital variable (DIV).

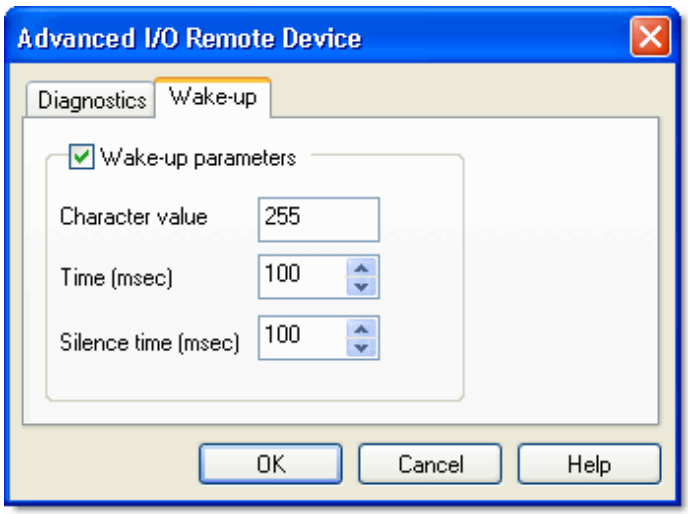
Condition: Condition of Tag 'Trigger' to start communication. With ultra low power RTU, communication works on edge conditions, to carry on communication as little as possible and therefore reduce consumption.

14.2.1. Remote Device – Advanced Properties

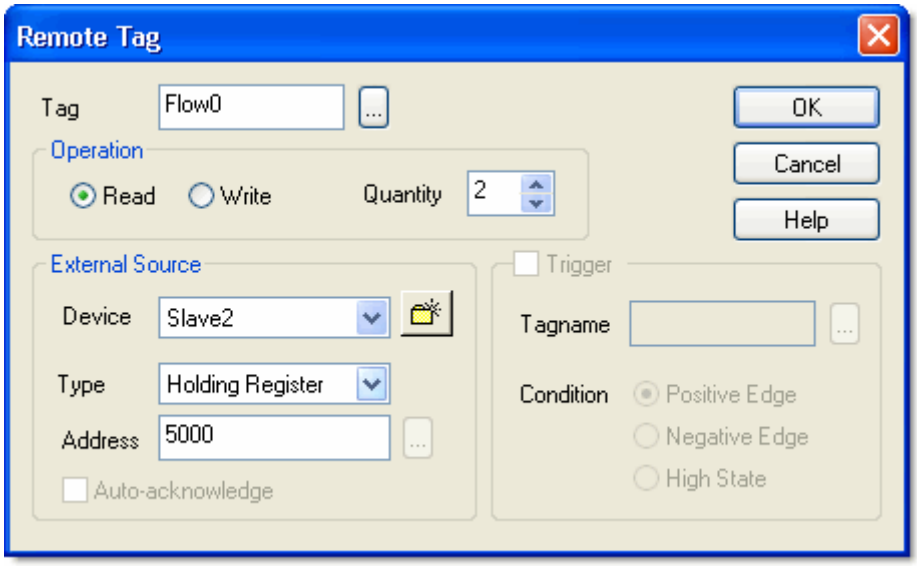
Click on "Advanced" button in above configuration to access advanced properties

An interesting feature related to low consumption device is "Wake-up frame".

TBox ULP can send a wake-up frame to the remote device before starting communication.



14.3. Creating a Remote Tag



Example: reading of 2 "Flow" variables in TBox#2 at address 5000

Tag: Select an existing Tag by clicking the [...] button. Be sure you select a Tag of the same type of the address you want to access in the 'Slave' (Byte, Word or Float).
If the Tag does not exist, you can create it after having clicked the button. It is the Tag of the **Master**; it contains the value you want to write in a Slave or it is a register that contains the value that Master reads in a Slave.
In case of block communication (with a quantity > 1), this Tag is the one of first ModBus address.

Operation :

Operations	MASTER (Tag)	SLAVE (Address)
READ	←	
	→	
WRITE		

Read : the Master executes a reading in the Slave.
Write : the Master executes writing in the Slave.

Quantity : Quantity of **variables** of successive addresses that are read (or written) in the Slave. It depends on the external source, the types of variable and the ModBus function used (see tables below).

ModBus protocol handles only words (16 bits). When working with 32 bits, TWinSoft adapts the quantity to double the number of words.
32 bits are handled with:
<Hi word1><Lo word1><Hi word2><Lo word2>...

External Source. All the following parameters concern the Slave station:

Device: select an existing external device from the 'Resources'. You can create one clicking the button

Type: select the type of the external variable. According to the external source, the choices are:

With external source '**ModBus device**' (another ***TBox ULP***, any ModBus device)

Types	Connection in remote device	ModBus Function
Digital input	Only digital input(s)	2
Coil	Digital output(s) or register(s)	1, 5 or 15
Analog input	Only analog input(s)	4
Holding register	Analog output(s) or register(s)	3, 6 or 16

Operations	Types	ModBus Functions	Max. Quantity (*)
Read Digital	Digital Input	2	**1600** (**see Warning below**)
Read Digital	Coil	1	**1600** (**see Warning below**)
Read Analog	Analog Input	4	**125** (16 bits) - **62** (32 bits)
Read Analog	Holding Register	3	**125** (16 bits) - **62** (32 bits)
Write Single Digital	Coil	5	**1**
Write Single Analog	Holding Register	6	**1** (word)
Write Multiple Digital	Coil	15	**800** (**see Warning below**)
Write Multiple Analog	Holding Register	16	**100** (16 bits) - **50** (32 bits)

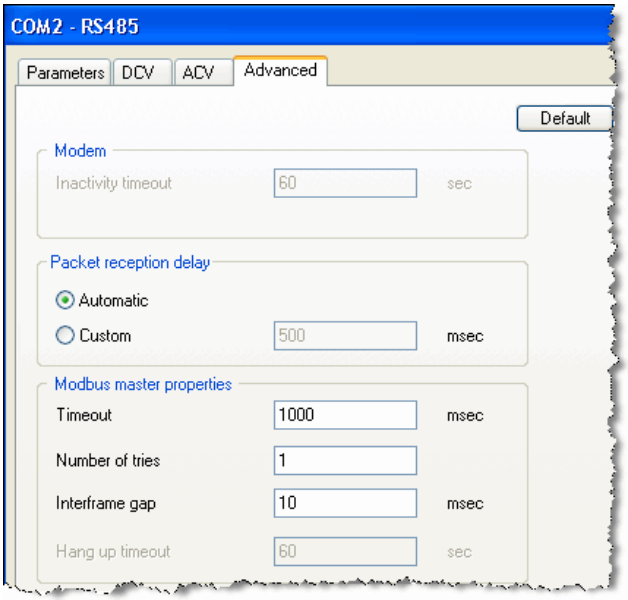
(*): Maximum quantities for ***TBox ULP***. You also have to check the maximum quantities of the 'Remote device'- they could be less.

Address : The ModBus address must be typed according to the indication of the user's guide of the Remote device.
Communicating to ***TBox ULP***, you have to refer to the TWinSoft application and its configuration of Tags.

14.4. Timing configuration of Remote Tags

Several timings can be adjusted when communication through Remote Tags. Their value mostly depends on the media and the baudrate (see on line help for more info).

They are available from the tab 'Advanced' of the properties of the communication port used to communicate with the remote device.



Packet reception delay: maximum time for receiving a valid answer

Master timeout: maximum time to receive an answer before sending the next query

Number of Tries: in case of error, number of times a query is sent

Interframe gap: after having received a valid answer, time before sending the next query.

15. Periodic Events

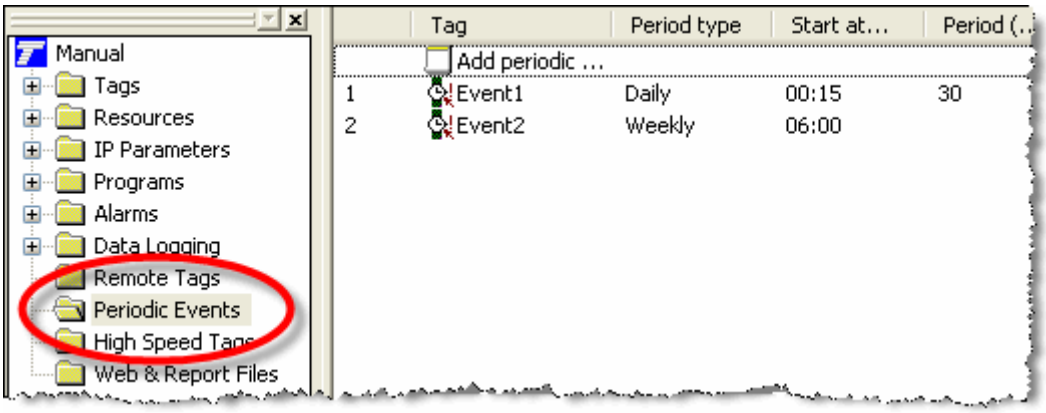
The idea is to enable events to be executed periodically, for example Remote Tags, alarm calls, datalogging, process, etc., independently of any other condition.

A periodic event could be compared to an automatic timer.

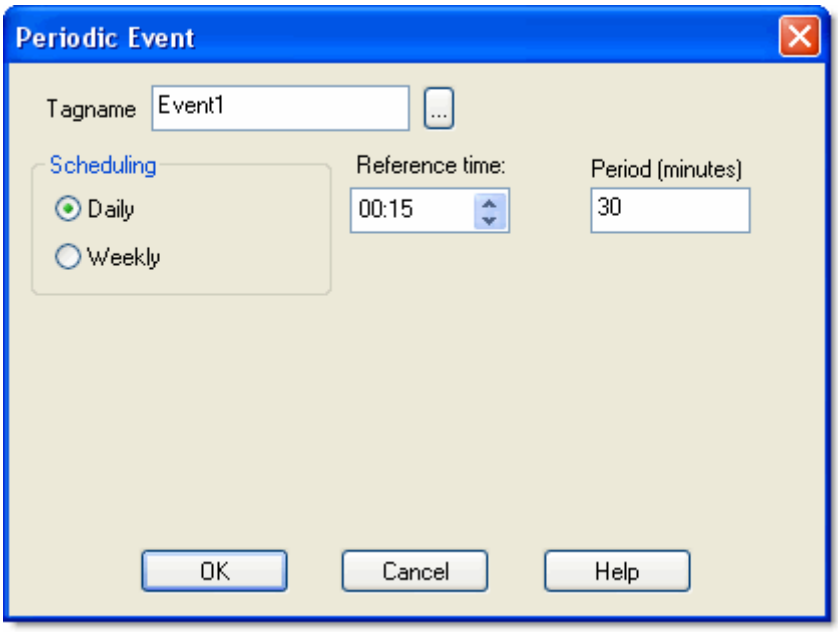
A digital Tag is Triggered periodically: it is automatically SET when the period has elapsed. All tasks associated to a positive edge on this Tag will be launched, then the Tag will be automatically RESET, ready for the next period.

Several tasks can be associated to the Tag triggered. This implies for the OS to RESET the Tag when all tasks have been launched.

In the project workspace of TWinSoft, a folder is available to declare the Periodic Events:

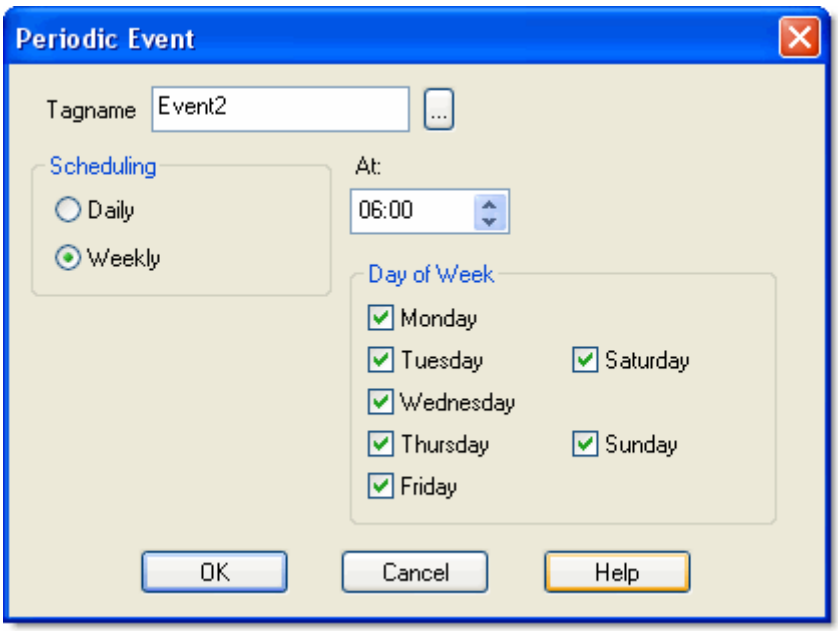


Example of a 'daily event':



The Tag 'Event1' (a DIV) will be automatically SET every 30 minutes, at each xx:15:00 and xx:45:00.
The task(s) associated to 'Event1' will be execute every 30 minutes.

Example of a 'weekly event':



The Tag 'Event2' (a DIV) will be automatically SET every day at 6:00:00 AM.
The task(s) associated to 'Event2' will be execute at that moment.

16. Access security

This (optional) access security of the ***TBox ULP*** prevents non-authorized persons from accessing the RTU and from opening the TWinSoft document.

If the Access security option is activated, each port of the ***TBox ULP*** can be independently protected. Once you activate the "Access security" option, the TWinSoft document will also be protected, even if no port has been selected!

The protection concerns 'ModBus' protocol, on serial and modem ports.

The protection is based on a four-digit hexadecimal global code that is saved in the ***TBox ULP***. This code allows different logins related to different users with different access levels to the ***TBox ULP***.

Three access levels are available to access protected port(s):

- Level 1: Surveillance mode or **VISUALIZATION MODE**. The operator can view all ***TBox ULP*** values (local or remote), but cannot execute any command.
- Level 2: **COMMAND MODE**, the operator can view all the values and execute commands (locally or remotely). Also known as **READ/WRITE MODE**.
- Level 3: **ENGINEER MODE**, the operator can view all the values, execute commands and send new application (locally or remotely).

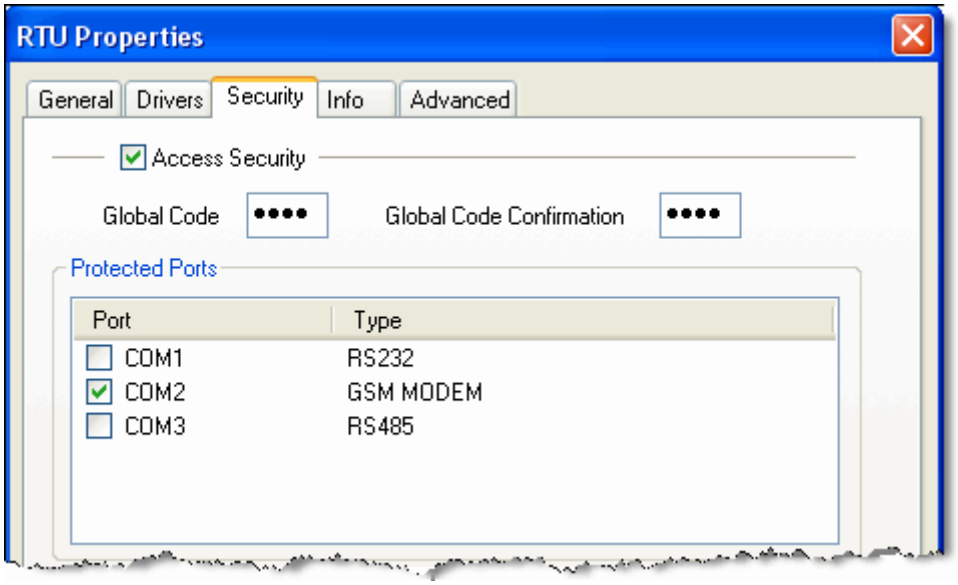
16.1. RTU configuration

The configuration of security of ***TBox ULP*** is available from the 'RTU properties':

- there is a general activation of the protection.
- for each port you activate the protection.

16.1.1. RTU Properties

From the RTU properties → tab 'Security', **you activate the general access security feature**.



Global code type in the code you used to generate the Access Codes with the utility **PASSWORD.EXE** (see chapter 16.3 below).
Type it a second time, to confirm.

TWinSoft presents you ports according to the ***TBox ULP*** you are configuring.

Next, you check the port you want to be protected.

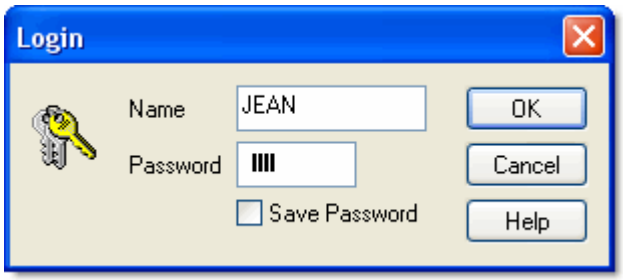
16.1.2. Port Properties

Access level on each port can be checked using the Analog Communication Variables (see chapter 8.6.2.).

16.2. TWinSoft document protected

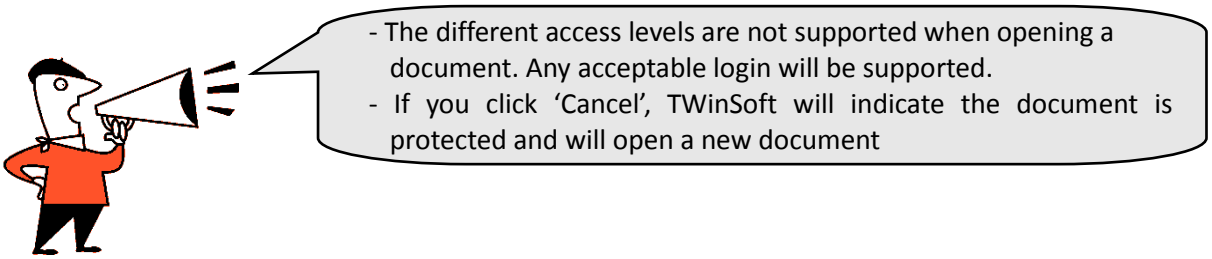
Opening a protected document

1. Once a document has been protected (see above), when opening it with TWinSoft, you are prompted to type a login.



2. Type the NAME and PASSWORD you have created with the Password generator (see below)

3. Click OK


- The different access levels are not supported when opening a document. Any acceptable login will be supported.
- If you click 'Cancel', TWinSoft will indicate the document is protected and will open a new document

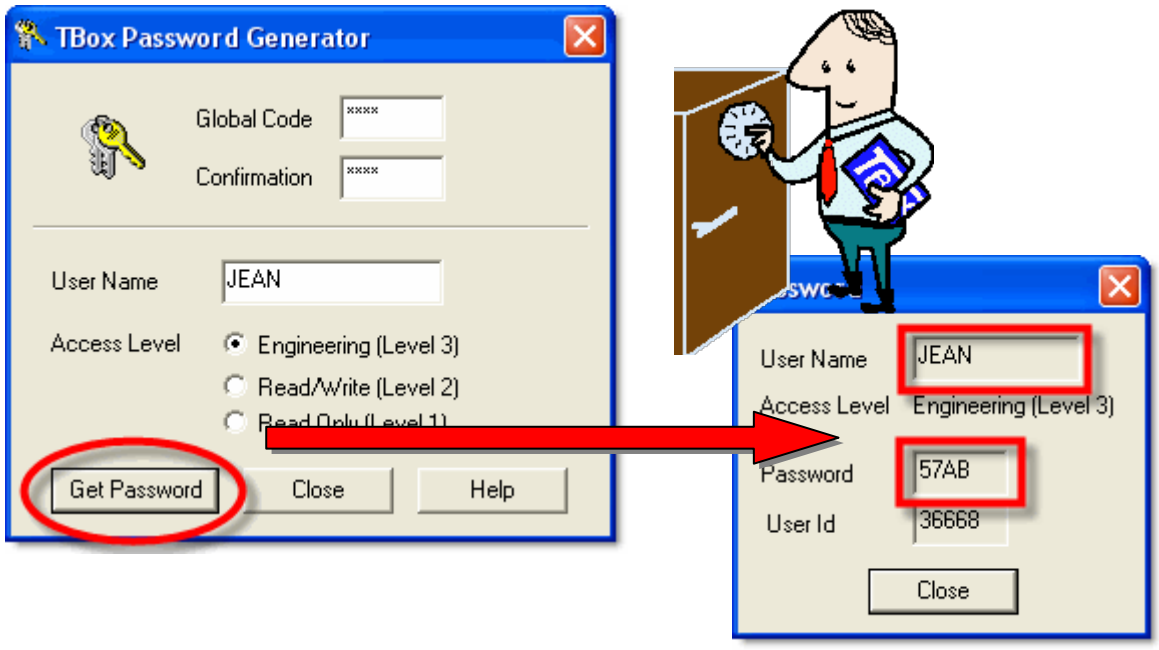
The utility program ***Password*** generates **access codes**.

16.3. Password utility

When installing *TWinSoft Suite* a password-creation program named **PASSWORD** is installed in the same directory as TWinSoft. It can be started from the 'Start' button of Windows and is located in the group of programs "Techno Trade" → "Accessories" created while installing TWinSoft.

This program generates a password that will be necessary to Login to the ***TBox ULP*** (see next).

This password is composed of 4 hexadecimal characters in response to information related to the user. It is based on a complex algorithm using the **global code**, the **user's name** and the **access level**. A 5-digit number that identifies persons who have accessed the ***TBox ULP*** accompanies the password. This information can be used to trace users for example by inserting this number into a database, with the help of Analog Communication Variables (see chapter 8.6.2.).



Global code This hexadecimal code of 4 characters is the basis for password generation. It is typed in the 'RTU Properties' (see above) of TWinSoft and sent to the ***TBox ULP***. When a user logs in, ***TBox ULP*** checks whether NAME and PASSWORD fit with the global code. This means that if different users with different access levels must communicate with ***TBox ULP***, the **global code used to generate passwords must be the same**.

User name The **NAME** you use as login.

Access level Three access levels are available:

- Level 1: Surveillance mode or **VISUALIZATION MODE**. The operator can view all ***TBox ULP*** values (local or remote), but can not execute any command.
- Level 2: **COMMAND MODE**, the operator can view all the values and execute commands (locally or remotely).
- Level 3: **ENGINEER MODE**, the operator can view all the values and execute commands and alter or send new TWinSoft documents (locally or remotely).

When this information has been entered, click on the button "Get password".

Two codes have been created:

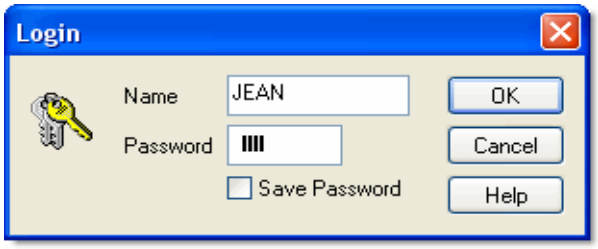
- *The PASSWORD:* this **PASSWORD** must be used together with the **NAME** when logging in.
- *The USER ID:* this number is available in an Analog Communication Variable when a user is connected to a port of ***TBox ULP*** that is protected.

16.4. Login/Logout

16.4.1. With TWinSoft

The Login feature of TWinSoft allows connecting to a protected port of the ***TBox ULP*** according to an access level. If a port is not protected, access level is automatically 3: Engineer.

The Login/Logout is executed from the main menu bar → 'Tools'.



Login

If connected to a port of ***TBox ULP*** that is protected, you need to Login to get an access level.

You type the Name you used in the 'Password' utility and the Password that was created (see previous). According to those, you are in:

- Read only mode
- Read/write mode
- Engineer

The access level is displayed in the Status bar.

If 'Save password' is checked and TWinSoft is connected to a protected port: when TWinSoft starts, it uses the access level corresponding to the password saved (see the status line).
If it is not checked and TWinSoft is connected to a protected port: TWinSoft starts in 'Read only' mode. You need to do a Login to get your access level.

Logout

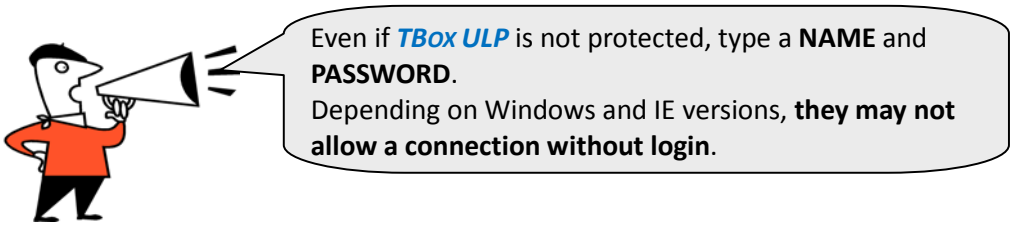
If the TWinSoft is connected to a protected port, the Logout sets TWinSoft in 'Read only' mode.

16.4.2. With Internet Explorer

Through a modem connection, you can access ***TBox ULP*** as Web Server.
From Internet Explorer, you use the tool TBox Dial It! to dial ***TBox ULP*** directly. ***TBox ULP*** is then considered first as an **ISP** and then as a Web Server.

To connect to an ISP you need to login

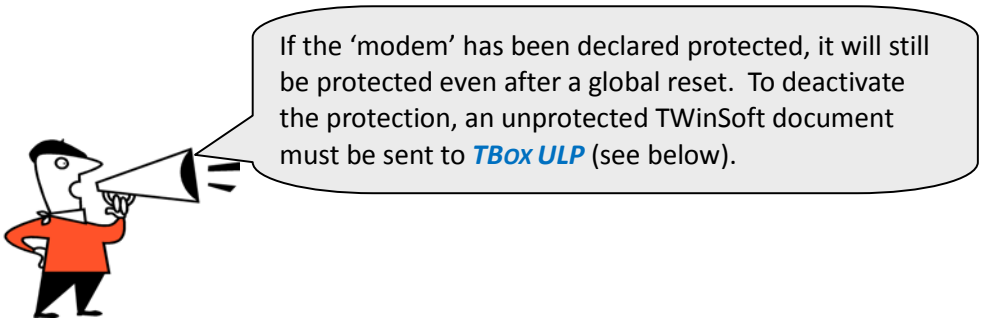
You type the **NAME** and **PASSWORD** you have used with password utility (see above)


Even if TBox ULP is not protected, type a NAME and PASSWORD.
Depending on Windows and IE versions, they may not allow a connection without login.

16.5. Deactivating protection

There are two methods of deactivating *TBox ULP* access protection:

Global reset (see chapter 5.6.)
The first method is by performing a global reset, which must be done on site. When the program has stopped, **the local port is no longer protected**.


If the 'modem' has been declared protected, it will still be protected even after a global reset. To deactivate the protection, an unprotected TWinSoft document must be sent to TBox ULP (see below).

Sending an unprotected TWinSoft document
The second method involves modifying the TWinSoft document and deactivating the Access Security option. The document is sent to the *TBox ULP* after having done a Login as 'Engineer'.

16.6. Deactivating protection of TWinSoft document

You have to open the document and de-activate 'Access security' in tab 'Security' (RTU properties).

If you have forgotten your login, but still remember the Global Code, you can generate a new login (see chapter 16.3. above).

If you have forgotten your login and the Global Code, you have to contact your local distributor and send him the application, the <application>.tws file.

Technical Specifications
-
Wiring

17. Technical specifications

17.1. Hazardous Environment

Depending on the model, ***TBox ULP*** can be used in hazardous environment.
TBox ULP is then considered as an **intrinsically-safe equipment** and can then be installed in Class1 Div1, and Class 1 Div2 or ATEX locations.

Intrinsically-safe equipment is defined as "equipment and wiring which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration." (ISA-RP12.6)
This is achieved by limiting the amount of power available to the electrical equipment in the hazardous area to a level below that which will ignite the gases.

When an Intrinsically-safe equipment needs to be connected to a device which is not intrinsically-safe, a barrier must be used to electrically isolate the hazardous area from the outside.
The basic design of an intrinsic safety barrier uses Zener Diodes to limit voltage, resistors to limit current and a fuse.

Most applications require a signal to be sent out of or into the hazardous area. The equipment mounted in the hazardous area must first be approved for use in an intrinsically safe system. The barriers designed to protect the system from non intrinsically-safe device must be mounted outside of the hazardous area in an area designated as Non-hazardous or Safe in which the hazard is not and will not be present.

17.2. Entity Concept

The Entity concept specifies parameters which any approved intrinsically safe device and barrier must meet.
The concept of Entity Approval allows inter-connections between different intrinsically safe apparatus, or barriers that have not been specifically approved as a complete system.

The parameters used for the Entity Approval are available as pair of parameters, as it concerns connecting two intrinsically safe apparatus:

Uo (or Uoc)	Maximum **Output Voltage** (or Open Circuit Voltage) that can appear at the connection.
Ui (or Umax)	Maximum **Input Voltage** that can be applied to the connection. **(**With **Uo** of associated apparatus **≤ Ui)**
Io (or Isc)	Maximum **Output current** (or Short Circuit Current) that can be taken from the connection.
Ii (or Imax)	Maximum **Input Current** that can be applied to the connection. **(**With **Io** of associated apparatus **≤ Ii)**
Po	Maximum **Output Power** that can be taken from the connection.
Pi	Maximum **Input Power** that can be applied to the connection. **(**With **Po** of associated apparatus **≤ i)**

Co	Maximum **External Capacitance** that can be connected to the connection.
Ci	Maximum equivalent **Internal Capacitance** that is considered as appearing at the connection. **(With Co ≥ Ci + cable)**
Lo	Maximum **External Inductance** that can be connected to the connection.
Ci	Maximum equivalent **Internal Inductance** that is considered as appearing at the connection. **(With Lo ≥ Li + cable)**

Capacitance and inductance of the wiring and cables must be included in the loop evaluation.

17.3. Entity Parameters

For each type of connection (Power Supply, RS232, RS485, DI, DO, AI), a series of entity parameters are provided in their respective chapter.
Some Entity Parameters are global for all connections of ***TBox ULP*** :

TBox WM:	***TBox LP:***
Co= 500 nF	Co= 1.3 µF
Lo= 250 µH	Lo= 350 µH
Lo/Ro= 73.3 µH/Ohm	Lo/Ro= 191.6 µH/Ohm

17.4. Barriers

In case ***TBox ULP*** is installed in hazardous environment and needs to be connected to a device not intrinsically-safe approved for used in hazardous area, an intrinsically-safe barrier must be wired between ***TBox ULP*** and the device.
The barrier must be installed in the non hazardous area.

17.5. General

CPU		
Processor	16 bits, 7.37 Mips	
Clock	Realtime Clock, backed-up (see schema following)	
Button	Push button : TEST - RESET	
Power Supply		
	WM-100, WM-200, LP-400	**LP-450**
Power Source	**Lithium Battery: SAFT LSH20**	**External LEAD Battery 12 VDC**
Quantity	1 or 2 batteries	1 battery
Energy	13 AH	-
Typical Voltage	3.6 VDC @ 25 °C	12 VDC @ 25 °C
Minimum Voltage	2 VDC	8 VDC
Maximum Voltage	-	16 VDC
Max. Continuous Current	1800 mA	-
Max. Peak Current	4000 mA/0.1 sec.	-
Operating Temperature	-20°C ..+70°C	-20°C ..+70°C
Current	On 3.6VDC:	On 12VDC:
Sleep mode	15 µA	50 µA
Run mode	15 mA	5.6 mA
RS 232 com.	1.5 mA @ 9600 bps	0.6 mA @ 9600 bps
RS 485 com.	1.5 mA @ 9600 bps	0.6 mA @ 9600 bps
GSM/GPRS com.	242 mA	91 mA
4 x DI slow sampling	20 µA	8 µA
1 x DI fast sampling	32 µA	12 µA
AI stage 4..20mA (24 V)	30 ms powering: 163 µA	30 ms powering: 62 µA
AI stage 0..5V (12 V)	30 ms powering: 40 µA	30 ms powering: 15 µA
LED “Test”	10 second flashing: 400 µA	10 second flashing: 150 µA

Check the battery life time, according to the frequency of sampling analog inputs and to the periods of communication.
Do a simulation using the EXCEL sheet *Consumption_ULP.xls* available in TWinSoft directory.

Protection	
Power Supply	Reverse polarity protection
FUSE *battery*	Soldered Fuse of 2 A. Not replaceable by user.
Memory	
Flash	Internal: 256 kbytes - loader: 16 kbytes - OS: 192 kbytes - application: 32 kbytes External: 512 kbytes: Web Files, Report, Sources, BASIC/Ladder (max. 64 kbytes)
Flash	Internal: 20 kbytes External (backed up with lithium battery): 128 kbytes (-LP4xx: + 256 kbytes) - Datalogging, Alarm Stacks, Tag Values: 72 kbytes - Datalogging Sampling Tables: 256 kbytes (-LP4xx) - application: 48 kbytes - buffer TCP: 24 kbytes

RS 232	
Connector	RJ45
Wiring (see schema next)	TxD, RxD, GND, RTS, CTS
Protocol	ModBus-RTU 'Slave' (for programming)
RS 485	
Connector	Spring-cage terminal block
Wiring (see schema next)	2 Wires: A, B
Number of slaves	256 (if RS485 technology of slaves allows it too)
Protocol	ModBus-RTU 'Master' and 'Slave'
Isolation	**No isolation** between signals A - B and Power Supply
Termination	Termination not required. *Failsafe bias* resistors included: pullup and pulldown resistors which assures a logical level TRUE when A and B are opened or in short-circuit.
Temperature	
Storage	-40…+70 °C
Working	-20...+70 °C
Hydrometry	5 to 95 % without condensation
Altitude	Maximum 4000 m.
Dimensions	**DIN Rail model - Rack1**
On Rack1, w/o connectors	Height x Depth x Width: **150** x **115** x **40mm** (5.9 x 4.53 x 1.58 inches)
Weight	300 gr
Dimensions	**IP68 model**
With glands	Height x Depth x Width: 140 x 76.2 x 177.8 mm (5.51 x 3 x 7 inches)
Weight (without battery)	1328 g

Certifications
See page 4

17.5.1. Button (Working modes)

On the front side of ***TBox ULP***, a button allows checking the working mode and resetting the CPU.
See chapters 5.6. and 5.8.

17.6. 5 VDC + LCD display (option)

5 VDC Power Supply	
Current	Max. 220 mA
LCD	
Lines	2x16 alphanumeric characters
Consumption	With backlight: 160 mA Without backlight: 30 mA
Operating temperature	0 .. + 50 °C
Protocol	ModBus-RTU: Row1 0000 write analog 8 Row2 0008 write analog 8 Backlight 0000 write digital 1 Transitor Out 0001 write digital 1 (Feature: / Address: / Operation: / Quantity:)
Transistor Output	Jumper J5. Max. current on 5 VDC: 250 mA

17.7. GSM (option)

Modem GSM/GPRS	
Model	SAGEM HiLo
Frequencies	Quad-BAND: GSM 850 / EGSM 900 / DCS 1800 / PCS 1900 MHz
GPRS	Class 10 (4+1/3+2) with support PBCCH , SMS and DATA
Emitting power	CLASS 4 (2W) for EGSM900 CLASS 1 (1W) for DCS1800 and PCS1900
Antenna connector	Screw connector, type FME Plug On field, use **ACC-GSM-ANT** (+3 dB external antenna), **ACC-GSM-ANT-FLAT** (+2 dB external flat mount antenna) or **ACC-GSM-CARANT** (magnetic car antenna). In Hazardous environment, a +0 dB antenna should be used: **ACC-GSM-ANTATEX**

17.8. RS232 & Switching (option)

IN ATEX MODEL (models with options -SM01),
THIS BOARD DOES NOT INCLUDE THE 12 VDC OUTPUT

RS232	
Connector	RJ50
Wiring (see schema next)	Full RS232 port, with 2 supplementary connections
Communication	Local or Modem
12 VDC Power Supply Output - NOT AVAILABLE IN ATEX MODEL	
Availability on models	WM100-S, WM200-S, LP400-S
Voltage (typical)	12 VDC
Current (max.)	350 mA
Protection	SMD fuse between battery and primary of power supply
Connector	Available on separate connector and RJ50 (see wiring)
Variable	Internal DO (D0.0.1.3) to switch the output
Switch of Power Supply Output	
Availability on models	WM100-S, WM200-S, LP400-S, LP450-S
Type	Current Sourcing (PNP transistor)
Voltage (max.)	30 VDC
Current - continuous (max.)	1.6 A
Current - peak (max.)	7 A during 5 ms. each 100 ms.
Protection	No protection
Connector	Available on separate connector (see wiring)
Variable	Internal DO (D0.0.1.4) to switch the output
Digital Output	
Type	Current Sinking (NPN transistor)
Voltage	Maximum: 30 VDC
Current	Maximum: 45 mA
Output Impedance	60 Ω
Protection	No protection
Connector	Available on RJ50 connector (see wiring)
Variable	Internal DO (D0.0.1.4) to switch the output (same DO as above)

17.9. I/O

Group 1 – Internal I/O		
AI_0:	**Battery 0**	with -WM and LP-400, voltage of Lithium battery 1 (both battery in //)
AI_1:	**Battery 1**	with -WM and LP-400, voltage of Lithium battery 2 (both battery in //)
AI_2:	**Internal Temp**	Temperature inside the module (°C)
D0_3:	**Enable 12 V**	with -S model, enable 12 V output
D0_4:	**Enable Swith Power**	with -S model, enable transistor switch
AI_5:	**DC Power voltage**	with LP-450 only, Input DC voltage

Group 2 - Digital Inputs Group 6 - Counter / Flow	
Principle of measurement - "Slow Sampling"	
Concerns the 4 DI of ***TBox WM*** and the 8 DI of ***TBox LP*** To avoid unnecessary consumption, ***TBox ULP*** acquires the digital inputs during a very short time on a regular base. 'Ultra Low Power' application supposes no external power, which means ***TBox ULP*** must power Digital Inputs. ***TBox ULP*** applies a voltage of 3.3V to a pull-up resistor during 739 µsec. After 500 µsec. ***TBox ULP*** reads the input. This mechanism is carried out 8 times per second	
Principle of measurement - "Fast Sampling"	
Concerns DI-0 and DI-1 when their associated variable "Counter HS" is Tagged. The 2 first DI act as interrupts on the microprocessor. The corresponding input stage in then powered permanently, to support high frequency (< 10 kHz)	
Digital Input	
Dry Contact, NPN transistor	Switch closed = logical '1' Switch open = logical '0'
Voltage at input	Voltage = 0 V = logical '1' (Switching '0' to '1' max. 2 V) Voltage > 2 V = logical '0' (Switching '1' to '0' min. 0.5 V)
Current at input	
Typical Source Current (with dry contact or NPN cabling)	33 µA
Sink Current @ 12 VDC (with incoming voltage cabling)	6.8 mA
Resistance at input	
Impedance	Typical 101 kΩ Minimum Typical 90 kΩ
Protection	
Inverted polarity	protected
Protection EMC	RC
Isolation	
Between inputs	No isolation
To the power supply	No isolation

"Counter" & "Flow" inputs	
The 4 inputs	4 Hz with a cycle ratio of 50 %
Wake up rate	Max. 1 minute
"Counter -HS" input	
DI-0 and DI-1	10 kHz
Number of pulses	Max. 65535 pulses between 2 wake up periods

Group 3 - Digital Outputs	
Output	
Type	Current Sinking (NPN transistor)
Voltage per output	Maximum: 30 VDC
Current per output	Maximum: 45 mA
Output Impedance	60 Ω
Protection	
	No protection
Isolation	
Between outputs	No isolation
To the power supply	No isolation

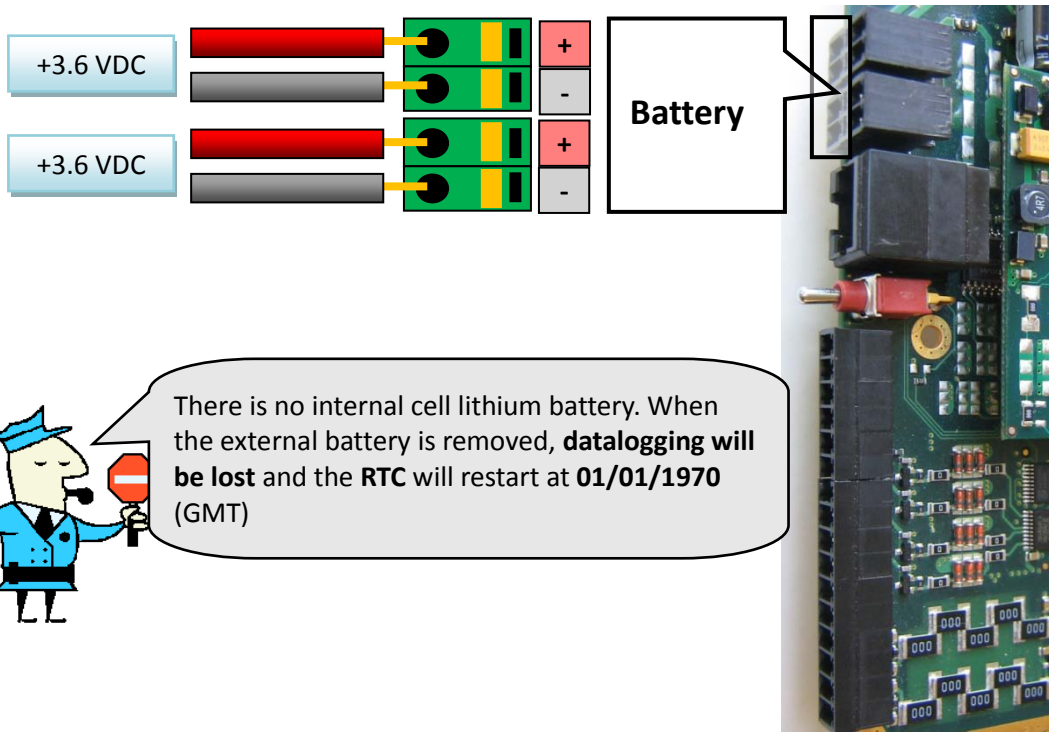
Group 4 - Analog Inputs Group 7 - Validity	
Principle of measurement	
Concerns the 2 AI of ***TBox WM*** and the 4 AI of ***TBox LP*** To avoid unnecessary consumption, ***TBox ULP*** reads Analog Inputs during a very short time on a regular base. 'Ultra Low Power' application supposes no external power, which means ***TBox ULP*** must power Analog Inputs (through V out). At a rate and during a period determined in the Tag configuration, ***TBox ULP*** applies a voltage of 12V. or 24V. to power the sensor. See configuration in chapter 8.7.4: ***Analog Inputs – Acquisition rate***	
V out	
+ 12 VDC	max. 45 mA
+ 24 VDC	max. 22 mA
4..20mA	
Resolution	12 bits
Mode	Unipolar
Precision	0.1 %
Input Impedance	Max. 25.3 Ω
Protection	Reverse current, over-current (up to 100mA), short circuit between AI power supply and current input (sensor short circuit).
DI: Validity input associated to each analog input 4..20mA	Returns '0' when signal < 2.4mA or > 21.6mA Returns '1' when the signal is valid.
0..5 V	
Resolution	12 bits
Mode	Unipolar
Precision	0.1%
Input Impedance	Typical: 104 kΩ
Protection	No protection
Isolation	
Between inputs	No isolation
To the power supply	No isolation

18. Wiring

18.1. Power Supply

18.1.1. -WM100, -WM200, -LP400

Connector: **Spring Cage Terminal block**
(see chapter 3.9)



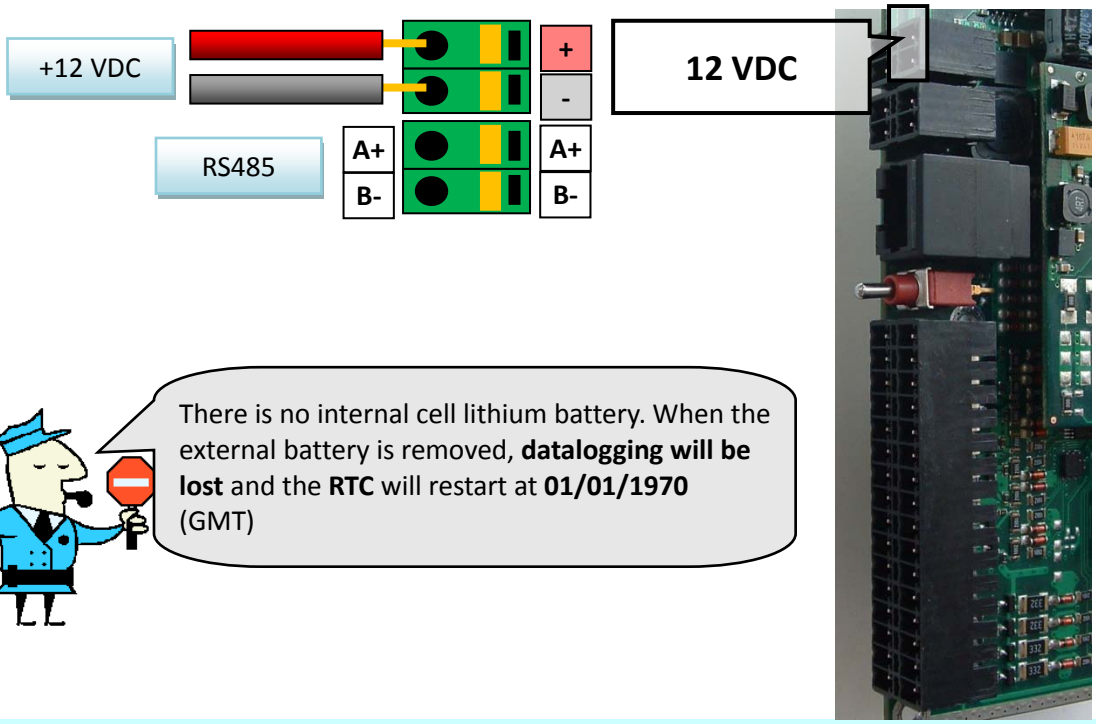
There is no internal cell lithium battery. When the external battery is removed, **datalogging will be lost** and the **RTC** will restart at **01/01/1970** (GMT)

POWER SUPPLY IN ATEX ENVIRONMENT

In ATEX environment, you have to use the battery pack **ATEX-BAT-PACK**.

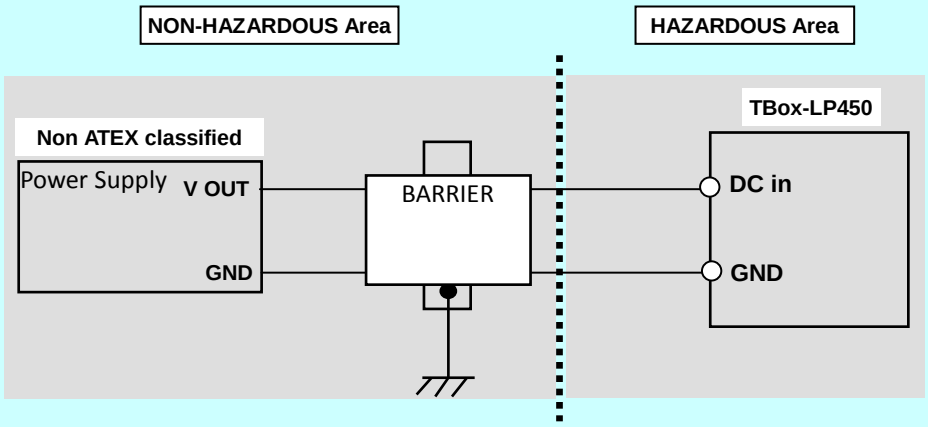
18.1.2. -LP450

Connector: **Spring Cage Terminal block**
(see chapter 3.9)



There is no internal cell lithium battery. When the external battery is removed, **datalogging will be lost** and the **RTC** will restart at **01/01/1970** (GMT)

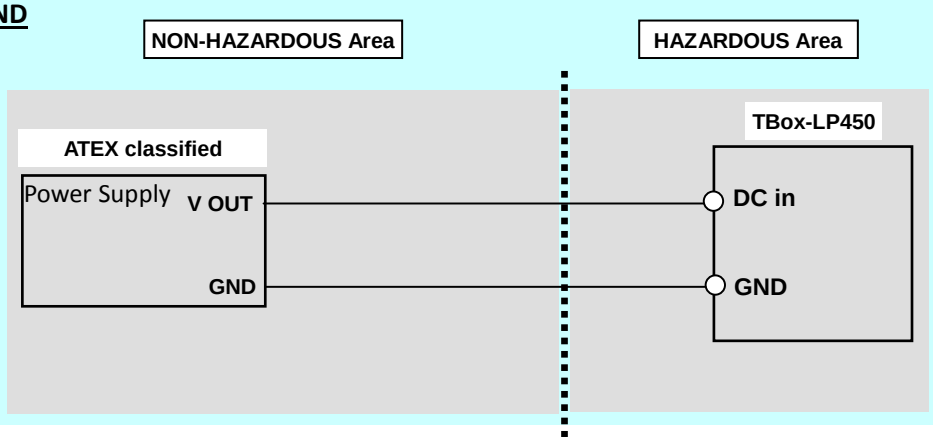
WIRING IN HAZARDOUS ENVIRONMENT



Entity Parameters

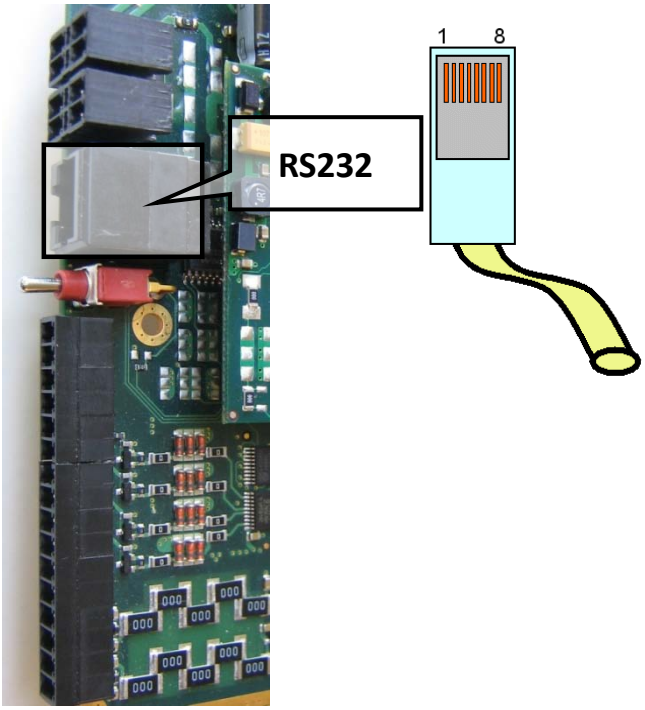
TBox LP450: **DC in-GND**

Ui= 17 V
Ii= 1.34 A
Pi= 5.69 W
Ci= 2 µF
Li= 0 µH



18.2. RS232 – Main Board

Description:	Connector:	Pin out:
RS232 communication	**RJ 45**	



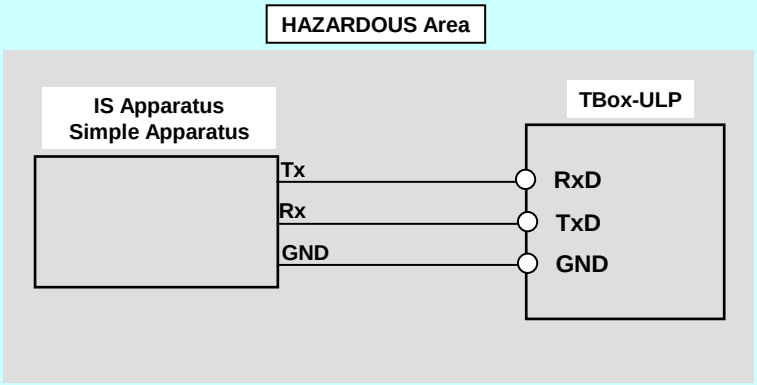
1. RI
2. DCD
3. DTR
4. Gnd
5. RxD (input)
6. TxD (output)
7. CTS (input)
8. RTS (output)

WIRING IN NORMAL ENVIRONMENT

Use RJ45 to DB9 adapter: ref. **MS-CONV-232**
Use DB9 serial cable: ref. **MS-CABL-PROG**

WIRING IN HAZARDOUS ENVIRONMENT

Wiring to Intrinsically-Safe Apparatus



Entity Parameters

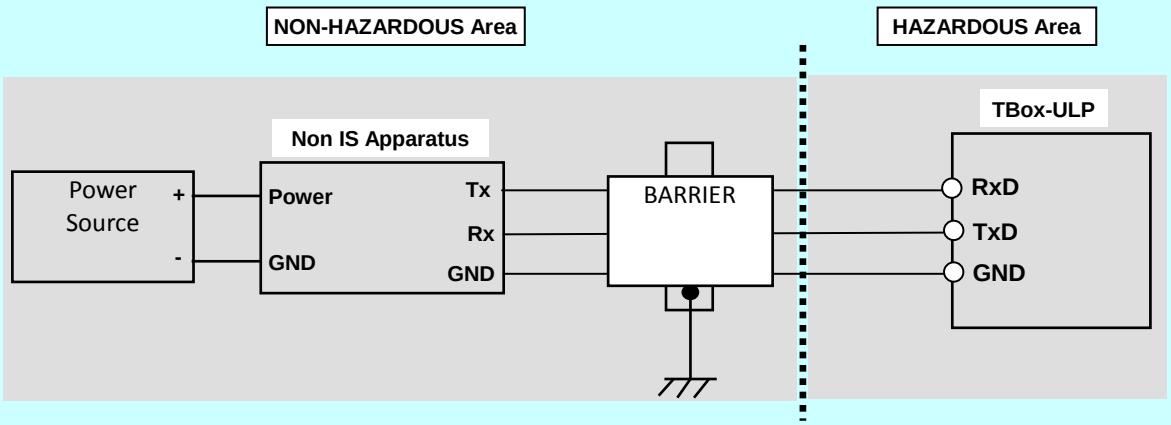
TBox WM: Rx/Tx-GND

Uo=8.51 V
Io= 37.5 mA
Po= 80 mW
Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 440 pF
Li= 0 µH

TBox LP: Rx/Tx-GND

Uo= 8.51 V
Io= 37.5 mA
Po= 80 mW
Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 440 pF
Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



Entity Parameters

TBox WM: Rx/Tx-GND

Ui= 15 V
Ii= 150 mA
Ci= 440 pF
Li= 0 µH

TBox LP: Rx/Tx-GND

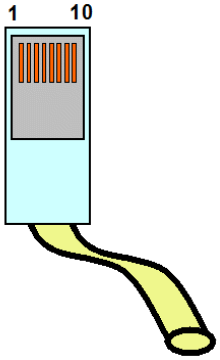
Ui= 15 V
Ii= 150 mA
Ci= 440 pF
Li= 0 µH

18.3. RS232 – Option Board

IN ATEX MODEL (with options -SM01),
THIS BOARD DOES NOT INCLUDE THE 12 VDC OUTPUT

Description:	Connector:	Pin out:
RS232 communication	**RJ 50**	**RJ 50**

RJ45 vs. RJ50
A RJ45 connector enters a RJ50 socket.
It uses pins 2 to 9 of RJ50 sockets and is then compatible with RJ45 socket.



1. **see jumper below**
2. RI (input)
3. DCD (input)
4. DTR (output)
5. Gnd
6. RxD (input)
7. TxD (output)
8. CTS (input)
9. RTS (output)
10. **see jumper below**

RS 232 Adapter between RJ45 and SUB-D 9 **+ Wiring to a PC**

Adapter		PC	Description	
RJ 45	DB-9	DB-9		
2 —	1	1	DCD	(Data Carrier Detect)
5 —	2	2	RxD	(Receive Data)
6 —	3	3	TxD	(Transmit Data)
3 —	4	4	DTR	(Data Terminal Ready)
4 —	5	5	GND	(Ground)
	6	6	DSR	(Data Set Ready)
8 —	7	7	RTS	(Request To Send)
7 —	8	8	CTS	(Clear To Send)
1 —	9	9	RI	(Ring indicator)

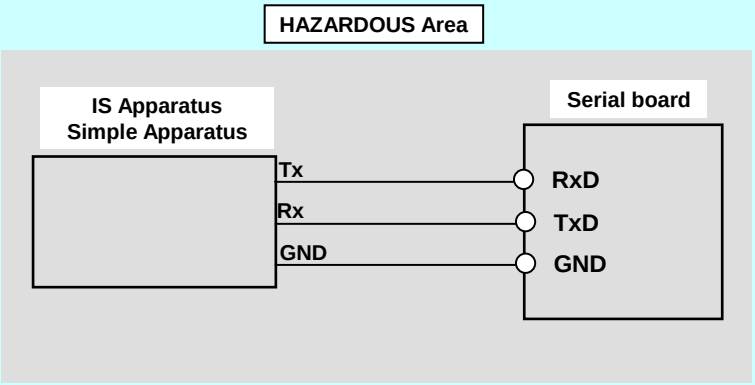
Reference adapter= **MS-CONV-232**
Reference RS232 cable= **MS-CABL-PROG**

WIRING IN NORMAL ENVIRONMENT

Use RJ45 to DB9 adapter: ref. **MS-CONV-232**
Use DB9 serial cable: ref. **MS-CABL-PROG**

WIRING IN HAZARDOUS ENVIRONMENT

Wiring to Intrinsically-Safe Apparatus



Entity Parameters

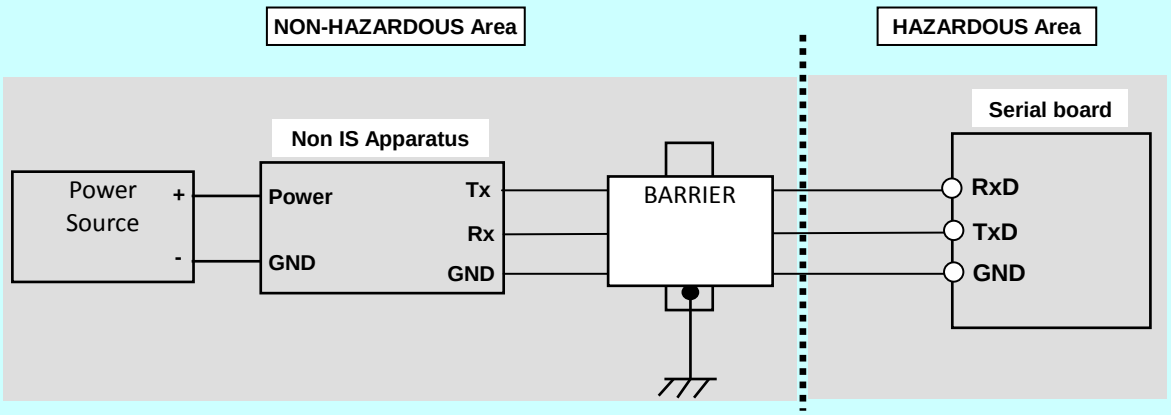
TBox WM: Rx/Tx-GND

Uo=8.51 V
Io= 67.2 mA
Po= 143 mW
Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 970 pF
Li= 0 µH

TBox LP: Rx/Tx-GND

Uo= 8.51 V
Io= 67.2 mA
Po= 143 mW
Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 970 pF
Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



Entity Parameters

TBox WM: Rx/Tx-GND

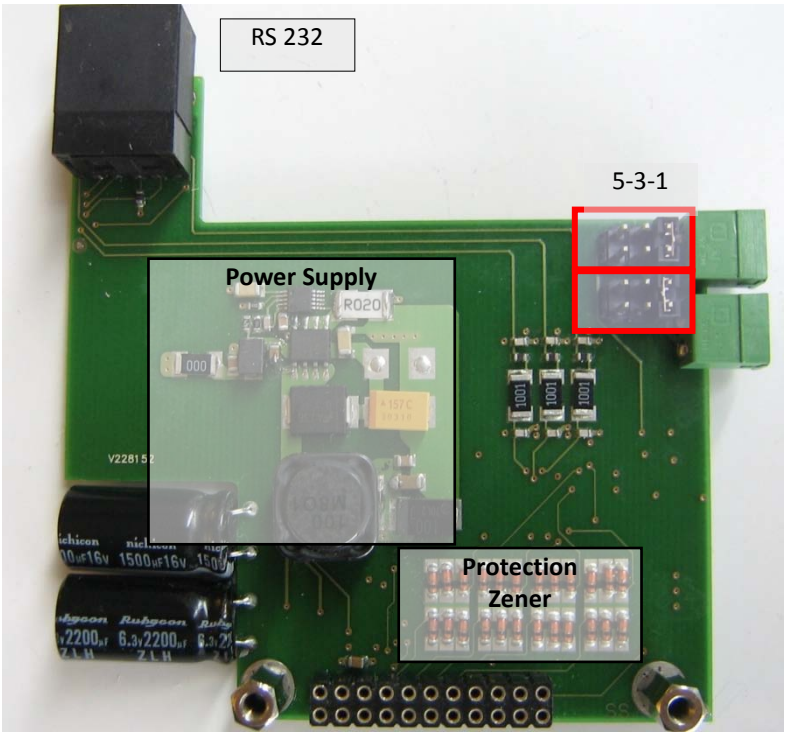
Ui= 15 V
Ii= 150 mA
Ci= 970 pF
Li= 0 µH

TBox LP: Rx/Tx-GND

Ui= 15 V
Ii= 150 mA
Ci= 970 pF
Li= 0 µH

18.3.1. Jumper Settings

Jumper allows assigning different signals to pin 1 and pin 10 of RJ50 connector.
You have to unscrew the serial board to access the jumper.



Jumper 1

Jumper 2

Example: Serial model for Class1, Div1 or normal environment

JUMPER SETTINGS for C1D1 and NORMAL ENVIRONMENT models:

Jumper connections	Jumper 1 - Pin1	Jumper 2 - Pin 10
: 1-2. 12 VDC (tot: 350mA)	+ 12 VDC. max. 175mA	+ 12 VDC. max. 175mA
: 3-4. "switch power" output (tot: 350mA)	"in" from connector "Switch Power". max. 175mA	"out" from connector "Switch Power" max. 175mA
: 5-6	Digital Output (NPN). See wiring	GND

JUMPER SETTINGS for ATEX models:

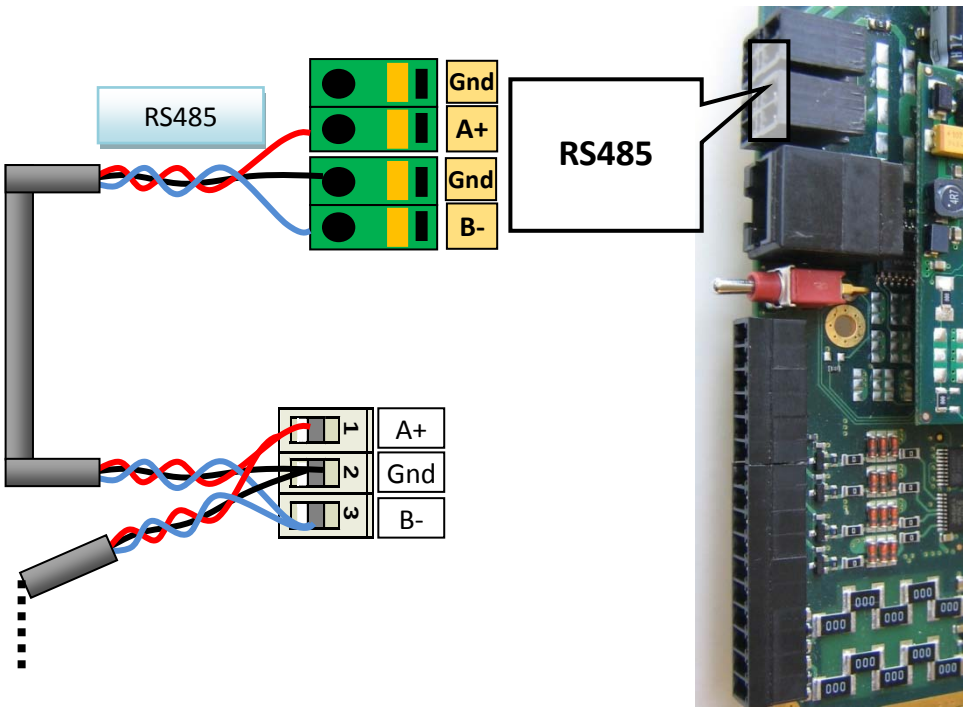
Jumper connections	Jumper 1 - Pin1	Jumper 2 - Pin 10
: 1-2. NO CONNECTION	NO CONNECTION	NO CONNECTION
: 3-4. "switch power" output (tot: 350mA)	"in" from connector "Switch Power". max. 175mA	"out" from connector "Switch Power" max. 175mA
: 5-6	Digital Output (NPN). See wiring	GND

See wiring the Digital Outputs at chapter 18.7.

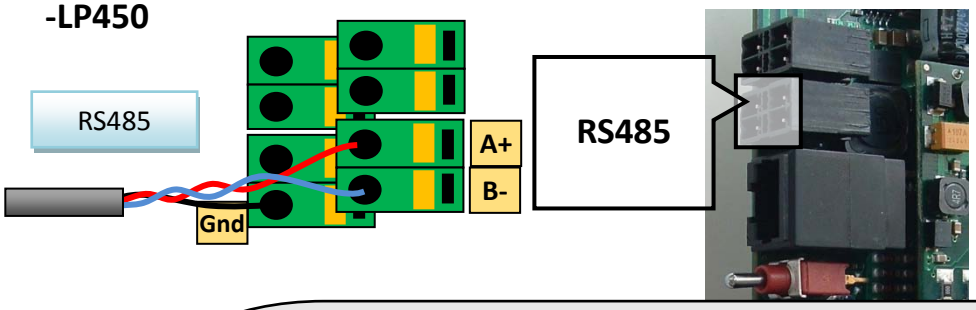
18.4. RS485 - Main Board

Description:	Connector:
RS485 communication	**Spring Cage Terminal block** (see chapter 3.9)

18.4.1. WM100, -WM200, -LP400



18.4.2. -LP450

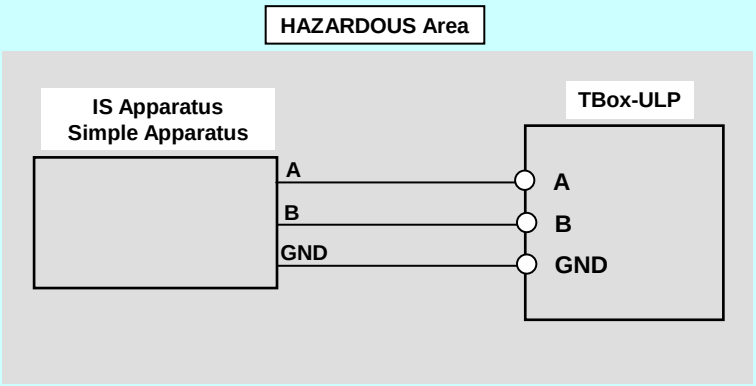


About RS485 cabling:

Use a twisted pair for signal A and B.
RS 485 is not isolated. If cabling equipment in different buildings (different Earth), you have to use ACC-RS485 (ask your local distributor)
Maximum length depends on quality of cable, speed and quantity of stations (max. 32 stations). In good condition, guaranteed to 1.2 km (max. 32 stations @ 9600 Bps)
In practice, longer distance can be reached with lower Baudrate and fewer stations.
Cable:
- Twisted pair (2 pairs)
- cross-section: minimum 0.5mm²
- screening : pair and global screening
- reference: Li2YCY-PiMF

WIRING IN HAZARDOUS ENVIRONMENT

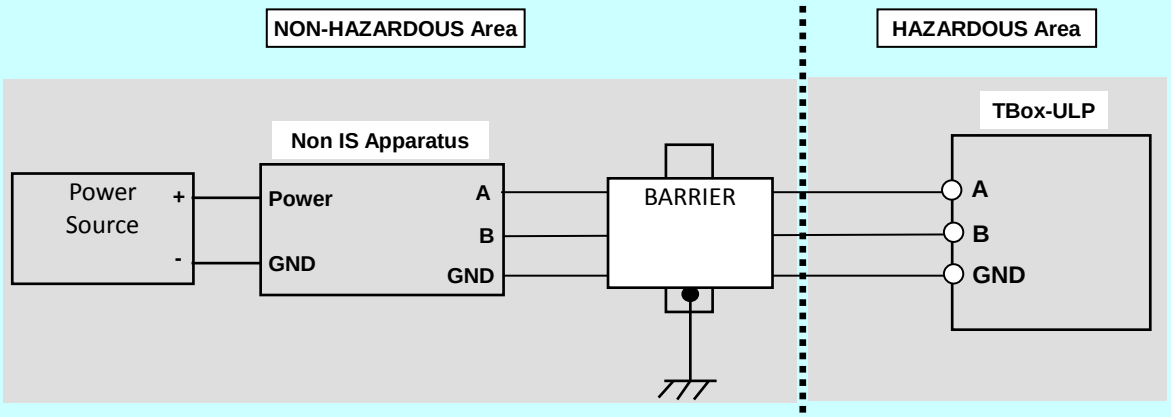
Wiring to Intrinsically-Safe Apparatus



Entity Parameters

TBox WM: A/B-GND	*TBox LP:* A/B-GND
Uo=8.51 V	Uo= 8.51 V
Io= 156 mA	Io= 156 mA
Po= 332 mW	Po= 332 mW
Ui= 8.51 V	Ui= 8.51 V
Ii= 310 mA	Ii= 310 mA
Pi= 660 mW	Pi= 660 mW
Ci= 220 pF	Ci= 220 pF
Li= 0 µH	Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



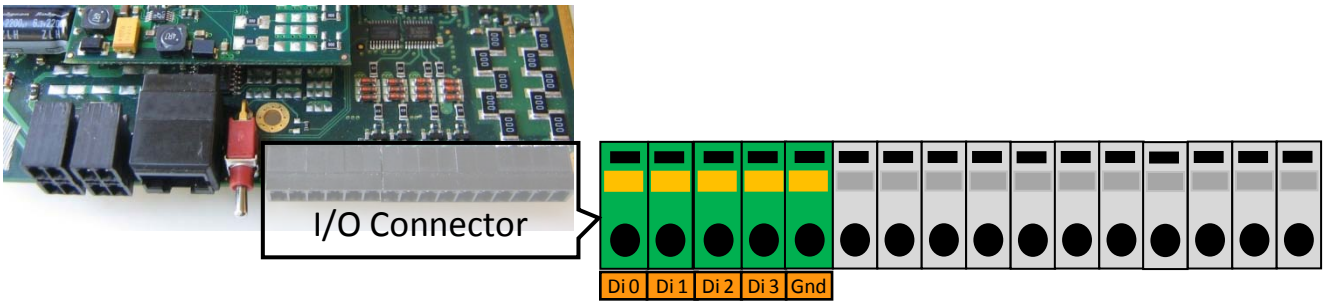
Entity Parameters

TBox WM: A/B-GND	*TBox LP:* A/B-GND
Ui= 8.51 V	Ui= 8.51 V
Ii= 310 mA	Ii= 310 mA
Ci= 220 pF	Ci= 220 pF
Li= 0 µH	Li= 0 µH

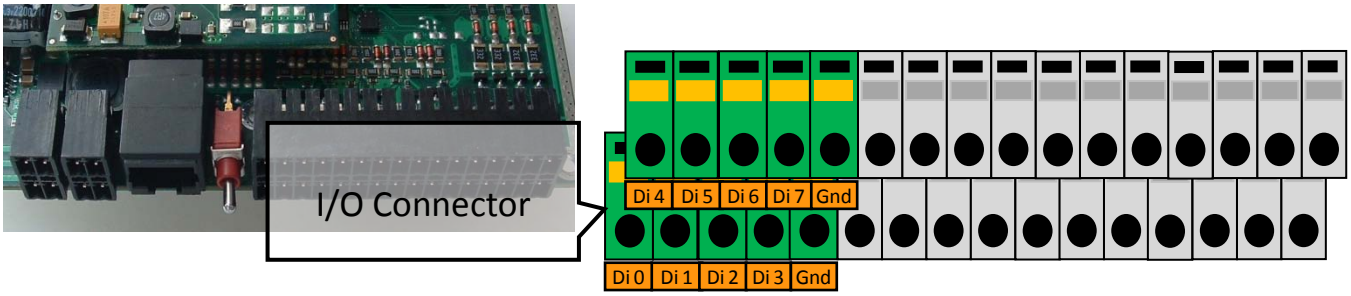
18.5. Digital Inputs - Counter inputs

18.5.1. -WM100, -WM200

Connector: **Spring Cage Terminal block**
(see chapter 3.9)

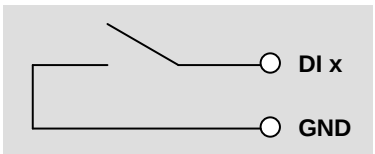


18.5.2. -LP400, -LP450

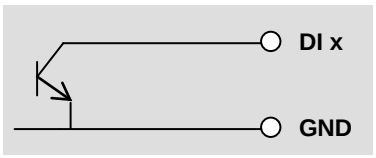


WIRING IN NORMAL ENVIRONMENT

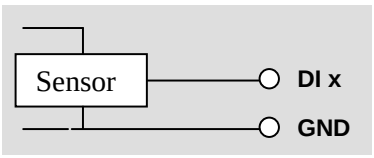
Dry contact



NPN transistor

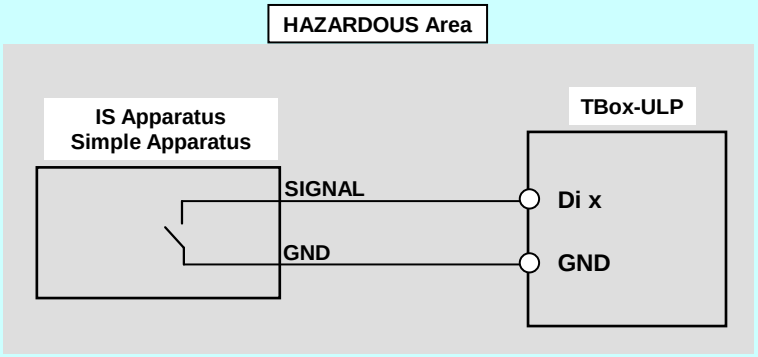


Voltage



WIRING IN HAZARDOUS ENVIRONMENT

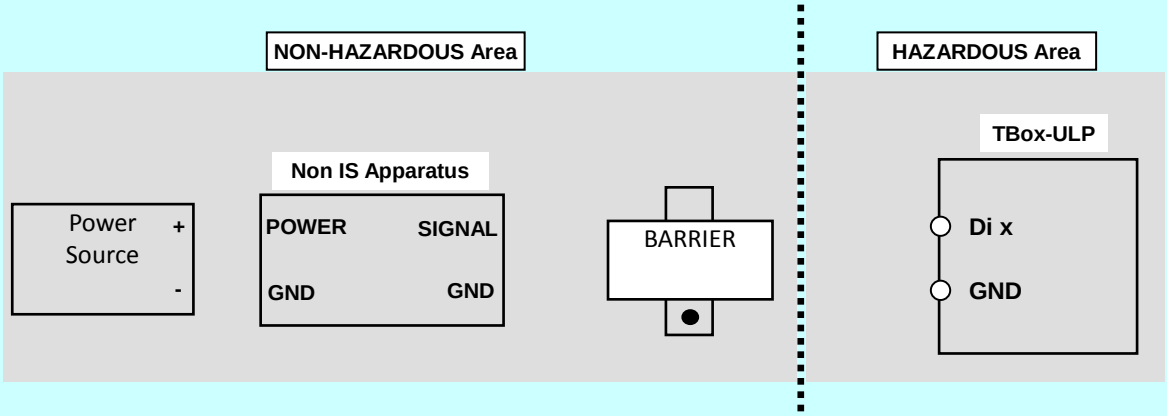
Wiring to Intrinsically-Safe Apparatus / Simple Apparatus



Entity Parameters

TBox WM: Di x-GND	*TBox LP:* Di x-GND
Uo= 7.51 V	Uo= 7.51 V
Io= 33.1 mA	Io= 66.1 mA
Po= 62 mW	Po= 124 mW
Ui= 10 V	Ui= 10 V
Ii= 100 mA	Ii= 100 mA
Pi= 250 mW	Pi= 250 mW
Ci= 440 pF	Ci= 880 pF
Li= 0 µH	Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



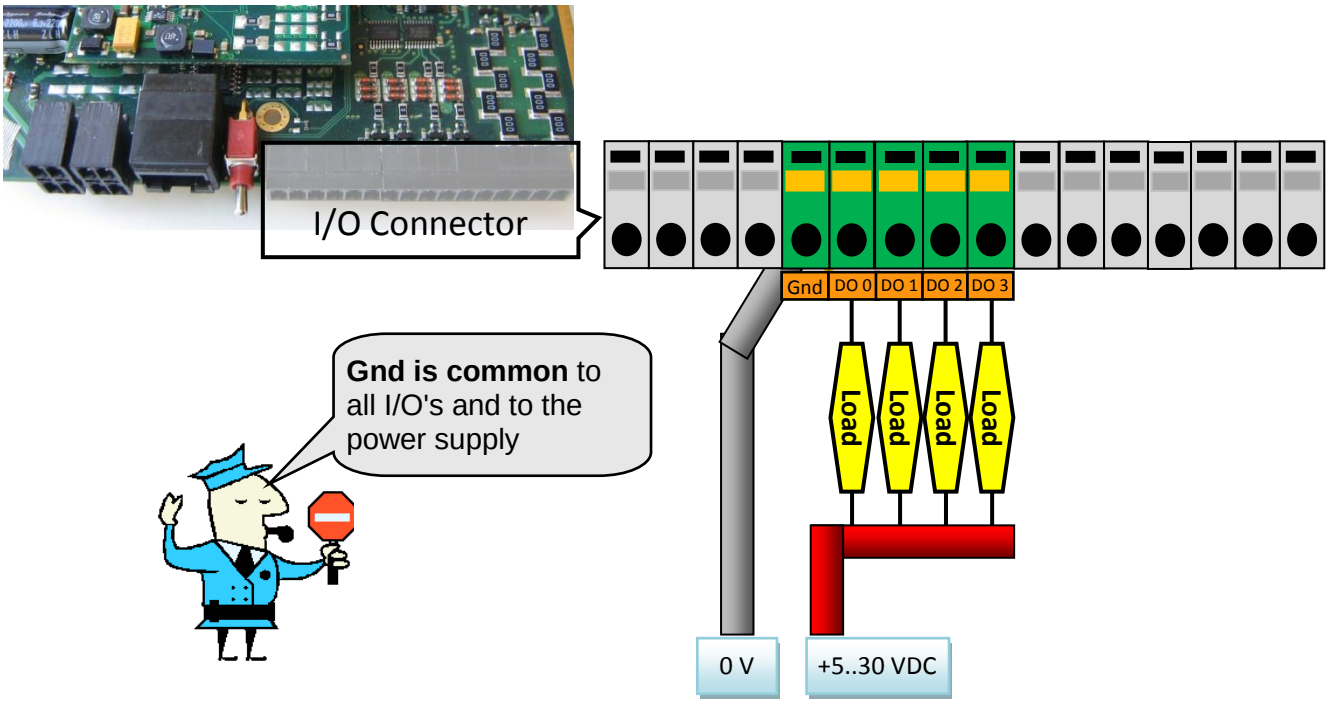
Entity Parameters

TBox WM: Di x-GND	*TBox LP:* Di x-GND
Ui= 10 V	Ui= 10 V
Ii= 100 mA	Ii= 100 mA
Pi= 250 mW	Pi= 250 mW
Ci= 440 pF	Ci= 880 pF
Li= 0 µH	Li= 0 µH

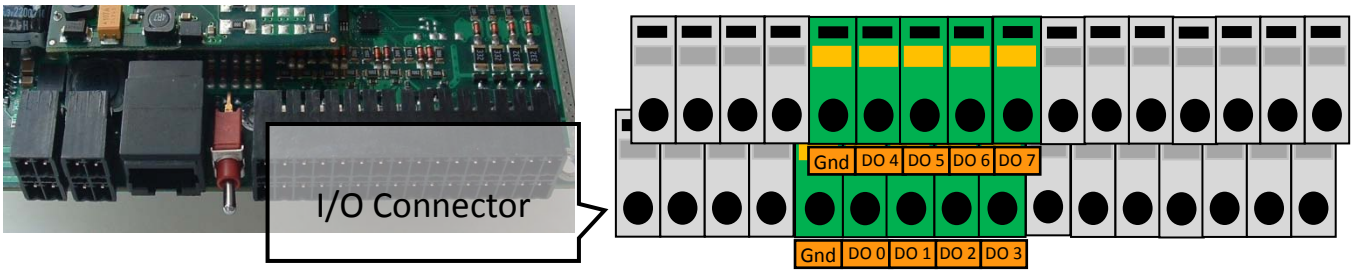
18.6. Digital Outputs - Main Board

18.6.1. -WM100, -WM200

Connector: **Spring Cage Terminal block**
(see chapter 3.9)



18.6.2. -LP400, -LP450

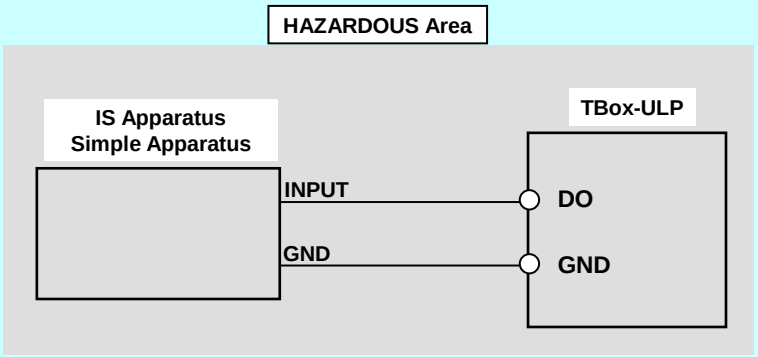


WIRING IN NORMAL ENVIRONMENT

See wiring above.

WIRING IN HAZARDOUS ENVIRONMENT

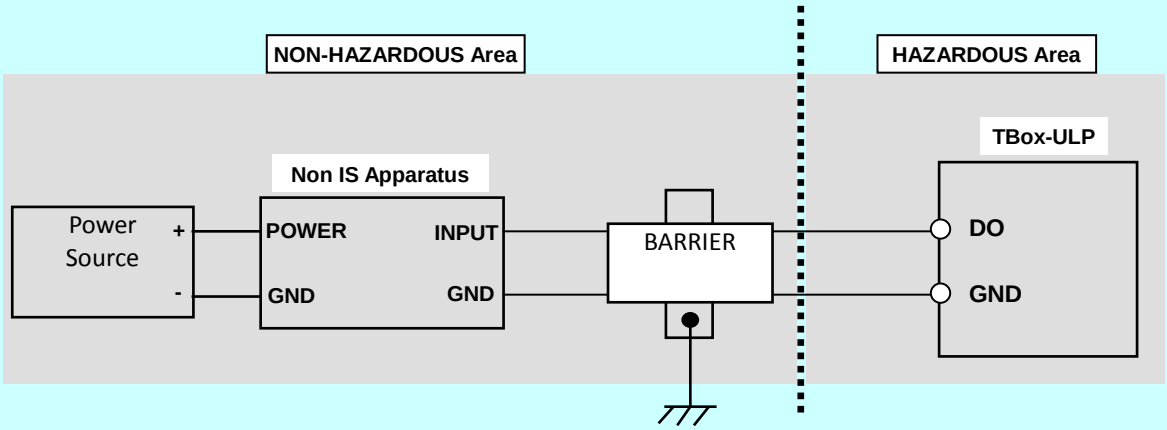
Wiring to Intrinsically-Safe Apparatus / Simple Apparatus



Entity Parameters

TBox WM: **DO x-GND**	***TBox LP:*** **DO x-GND**
Uo= 7.51 V	Uo= 7.51 V
Io= 3.31 mA	Io= 6.61 mA
Po= 6.2 mW	Po= 12.4 mW
Ui= 10 V	Ui= 10 V
Ii= 100 mA	Ii= 100 mA
Pi= 250 mW	Pi= 250 mW
Ci= 880 pF	Ci= 1.32 nF
Li= 0 µH	Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



Entity Parameters

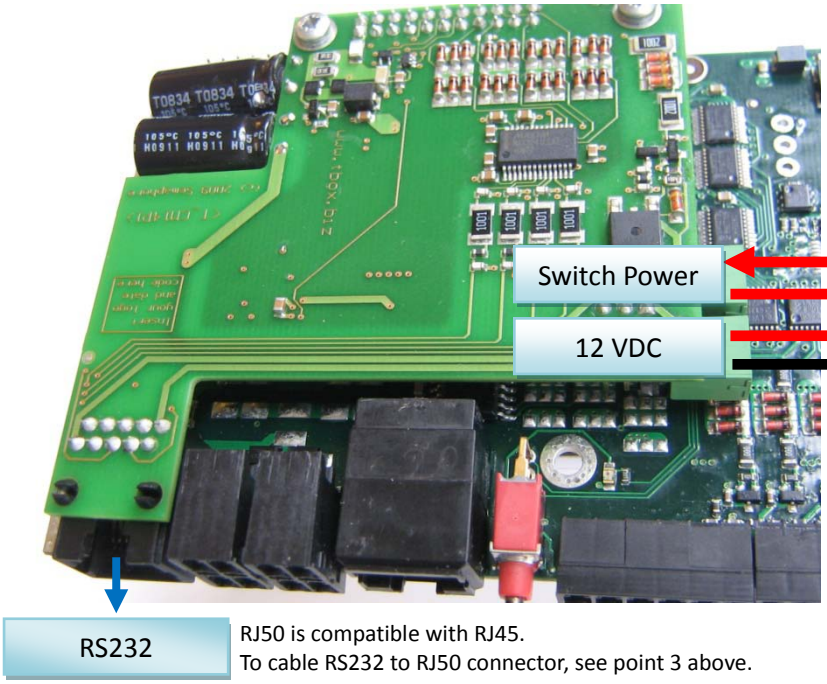
TBox WM: **DO x-GND**	***TBox LP:*** **DO x-GND**
Ui= 10 V	Ui= 10 V
Ii= 100 mA	Ii= 100 mA
Pi= 250 mW	Pi= 250 mW
Ci= 880 pF	Ci= 1.32 nF
Li= 0 µH	Li= 0 µH

18.7. Digital Outputs - Option Board

The Serial Option board is also equipped with:

- an **internal 12 VDC** output (for instance to power an **external modem**)
  THIS OUTPUT IN NOT AVAILABLE ON ATEX MODEL
- a NPN digital output
- an electronic switch, to switch an external power

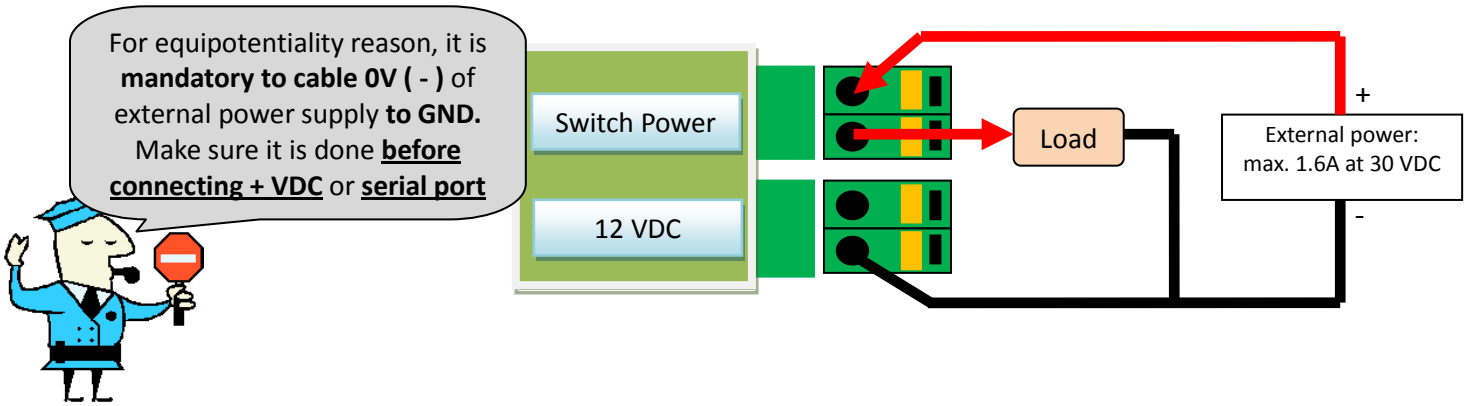
Connectors



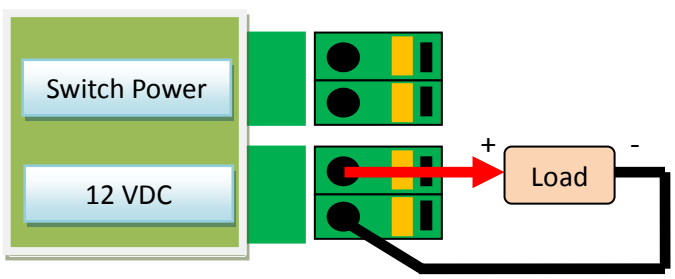
RJ50 is compatible with RJ45.
To cable RS232 to RJ50 connector, see point 3 above.

WIRING IN NORMAL ENVIRONMENT

Wiring External Power Supply

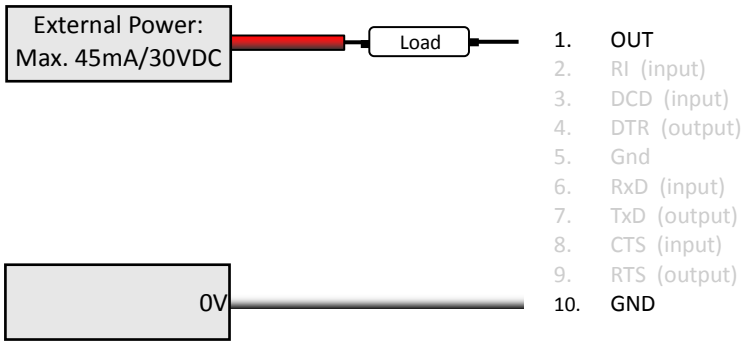

For equipotentiality reason, it is **mandatory to cable 0V (-)** of external power supply **to GND.** Make sure it is done **before connecting + VDC** or **serial port**
Switch Power
12 VDC
Load
External power:
max. 1.6A at 30 VDC
+
-

Wiring 12 VDC output



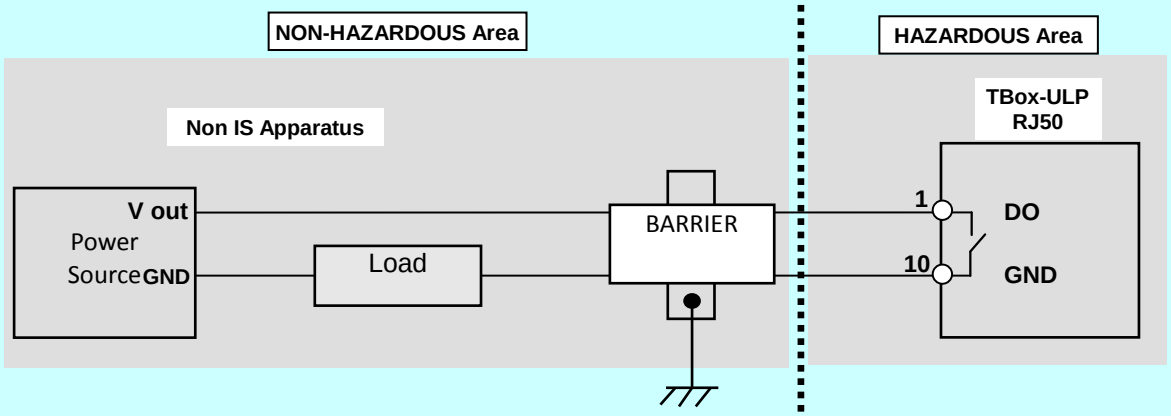
Pins 1 and 10 of RJ50 can be connected to different signals (See jumper settings at chapter 18.3.1).
When the digital output NPN is cabled, use the following wiring:

Wiring Digital Output (NPN)

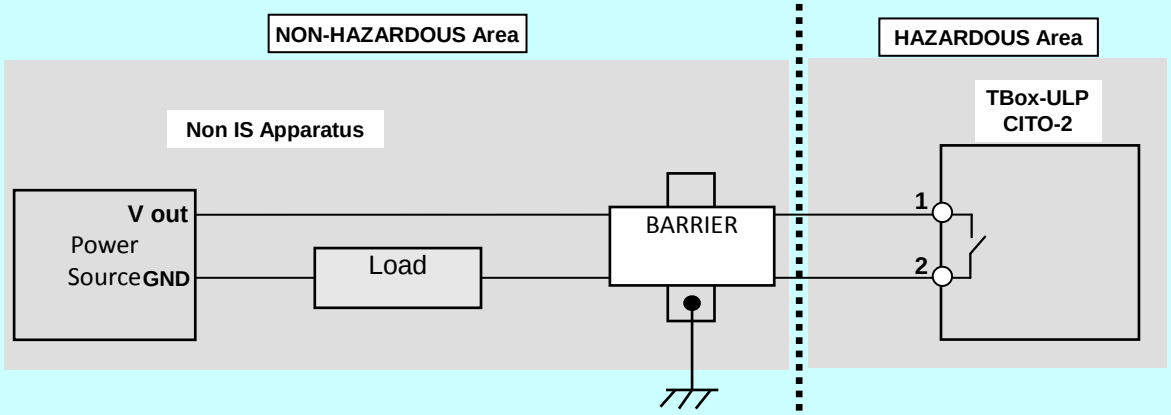


WIRING IN HAZARDOUS ENVIRONMENT

Wiring Digital Output (NPN)



Wiring Switch Power



Entity Parameters

TBox WM: Output-GND

Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 970 pF
Li= 0 µH

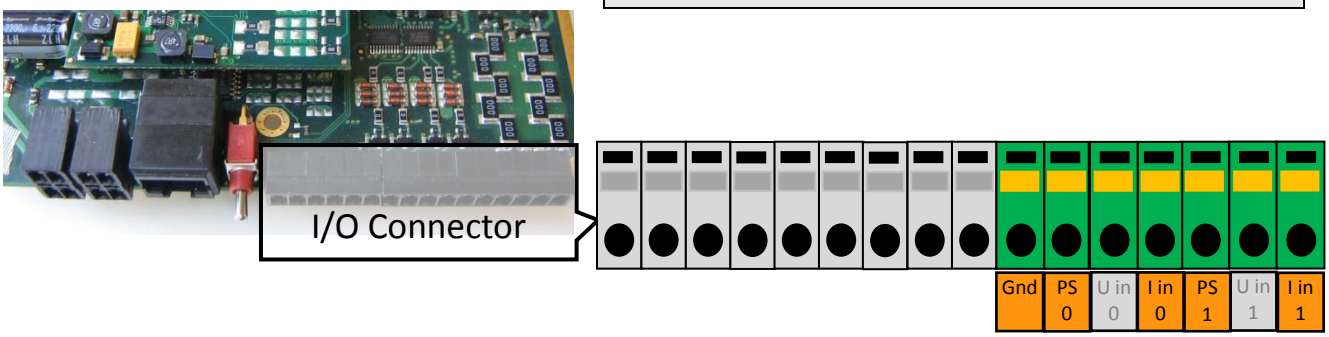
TBox LP: Output-GND

Ui= 15 V
Ii= 150 mA
Pi= 560 mW
Ci= 970 pF
Li= 0 µH

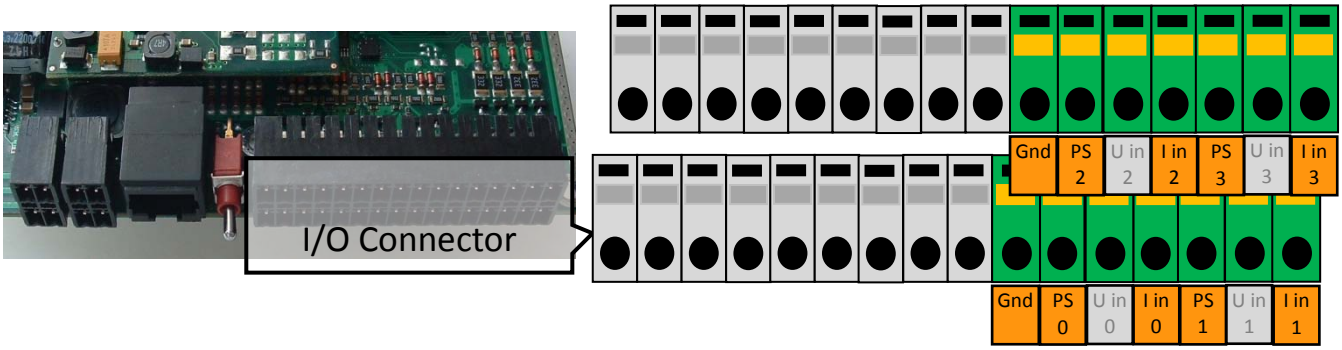
18.8. Analog Inputs – Current

18.8.1. -WM100, -WM200

Connector: **Spring Cage Terminal block**
(see chapter 3.9)



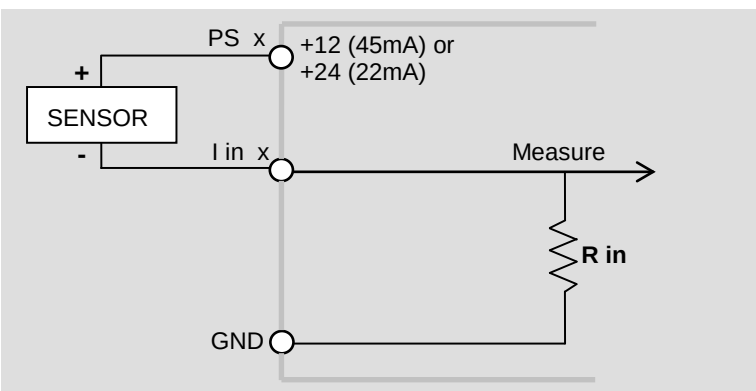
18.8.2. -LP400, -LP450



In order to save energy, ***TBox ULP*** controls the power of the sensor. It activates power on pin PS x at a frequency and a period defined in the Tag configuration (see chapter 8.7.4. ***Analog Inputs – Acquisition rate***).

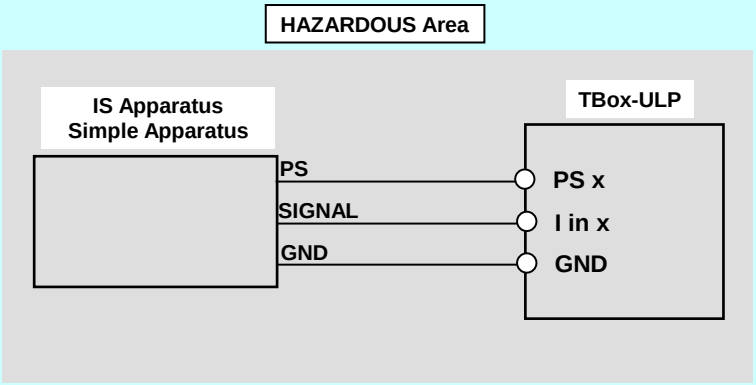
WIRING IN NORMAL ENVIRONMENT

Wiring to 2-wires sensor



WIRING IN HAZARDOUS ENVIRONMENT

Wiring to Intrinsically-Safe Apparatus / Simple Apparatus



Entity Parameters

TBox WM:		***TBox LP:***	
I in x-GND	**PS-GND**	**I in x-GND**	**PS-GND**
Uo= 8.51 V	Uo= 29.35 V	Uo= 8.51 V	Uo= 29.35 V
Io= 113.3 mA	Io= 181.74 mA	Io= 8.7 mA	Io= 92.65 mA
Po= 241 mW	Po= 1.33 W	Po= 18.44 mW	Po= 680 mW
Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V
Ii= 120 mA	Ii= 100 mA	Ii= 100 mA	Ii= 100 mA
Pi= 881 mW	Pi= 734 mW	Pi= 734 mW	Pi= 734 mW
Ci= 660 pF	Ci= 44 nF	Ci= 1.32 nF	Ci= 88 nF
Li= 0 µH	Li= 0 µH	Li= 0 µH	Li= 0 µH

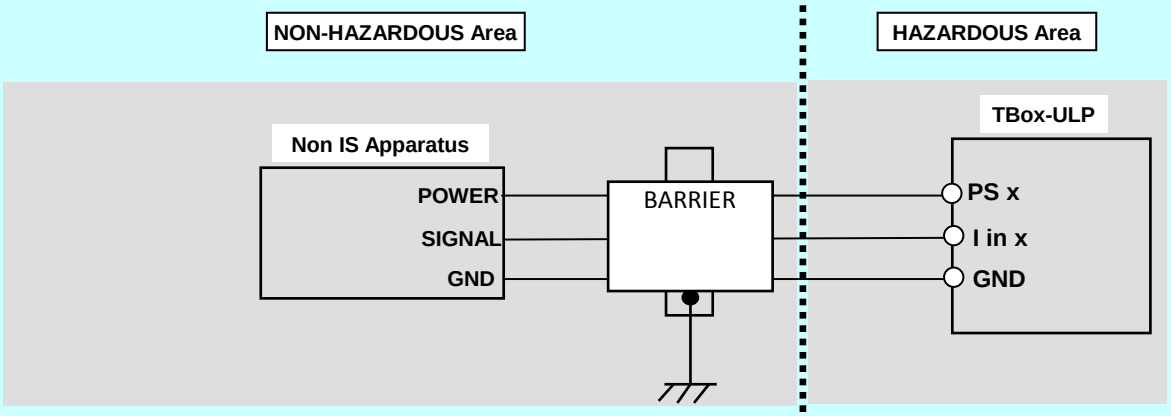
Analog Input: Current Sensor with 2 wires

TBox WM:	***TBox LP:***
I in x - PS	**I in x - PS**
Uo= 29.35 V	Uo= 29.35 V
Io= 86.05 mA	Io= 91.35 mA
Po= 658 mW	Po= 91.2 mW
Ci= 44.66 nF	Ci= 89.32 nF
Li= 0 µH	Li= 0 µH

Analog Input: Current Sensor with 3 wires

TBox WM:	***TBox LP:***
I in x + PS - GND	**I in x + PS - GND**
Uo= 29.35 V	Uo= 29.35 V
Io= 204.2 mA	Io= 98.90 mA
Po= 1.50 W	Po= 726 mW
Ci= 44.66 nF	Ci= 89.32 nF
Li= 0 µH	Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



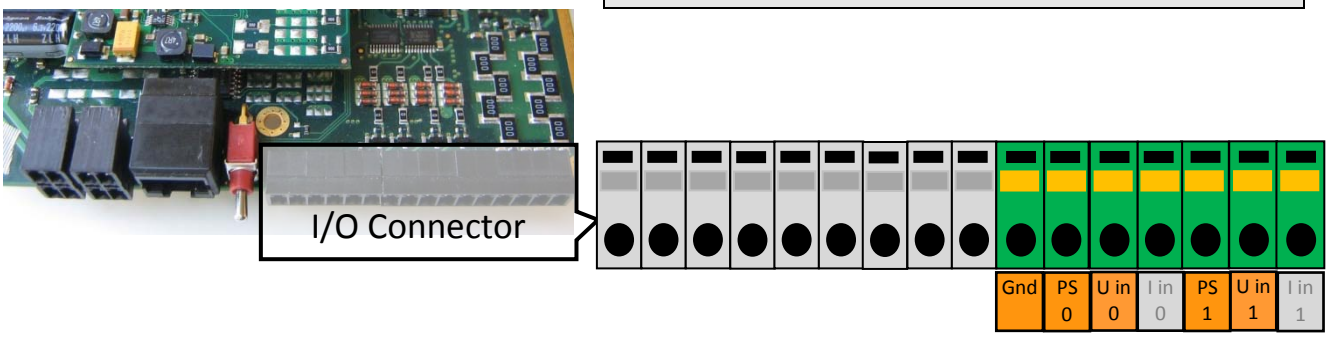
Entity Parameters

TBox WM:		TBox LP:	
I in x-GND	**PS-GND**	**I in x-GND**	**PS-GND**
Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V
Ii= 120 mA	Ii= 100 mA	Ii= 100 mA	Ii= 100 mA
Pi= 881 mW	Pi= 734 mW	Pi= 734 mW	Pi= 734 mW
Ci= 660 pF	Ci= 44 nF	Ci= 1.32 nF	Ci= 88 nF
Li= 0 µH	Li= 0 µH	Li= 0 µH	Li= 0 µH

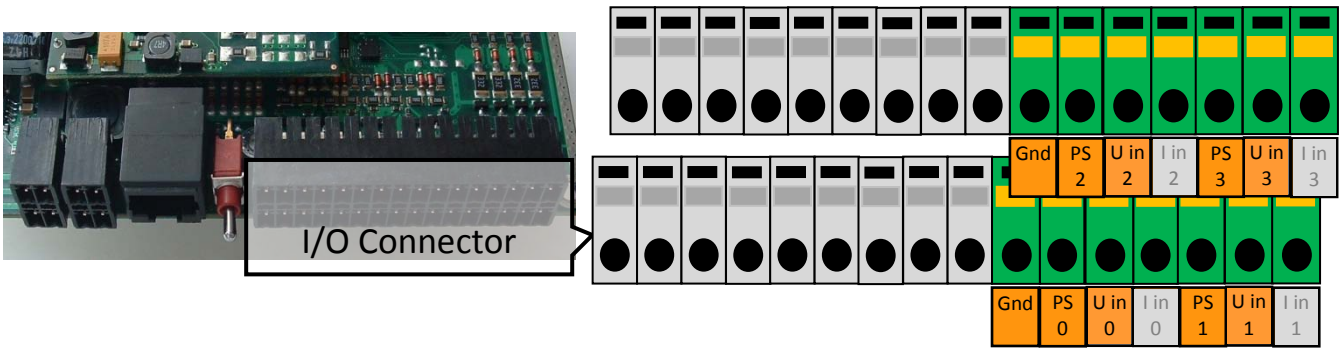
18.9. Analog Inputs – Voltage

18.9.1. -WM100, -WM200

Connector: **Spring Cage Terminal block**
(see chapter 3.9)



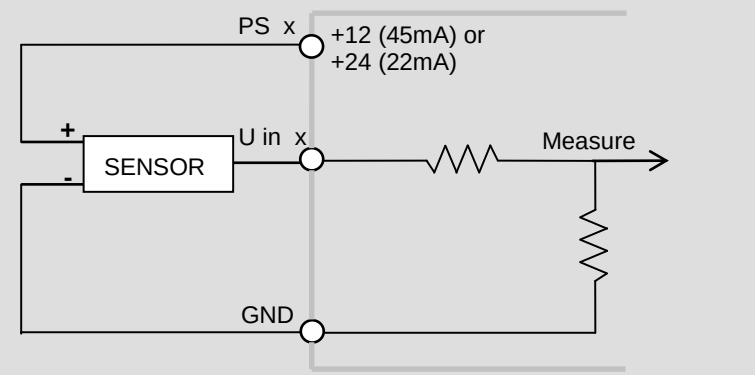
18.9.2. -LP400, -LP450



In order to save energy, ***TBox ULP*** controls the power of the sensor. It activates power on pin PS x at a frequency and a period defined in the Tag configuration (see chapter 8.7.4. ***Analog Inputs – Acquisition rate***).

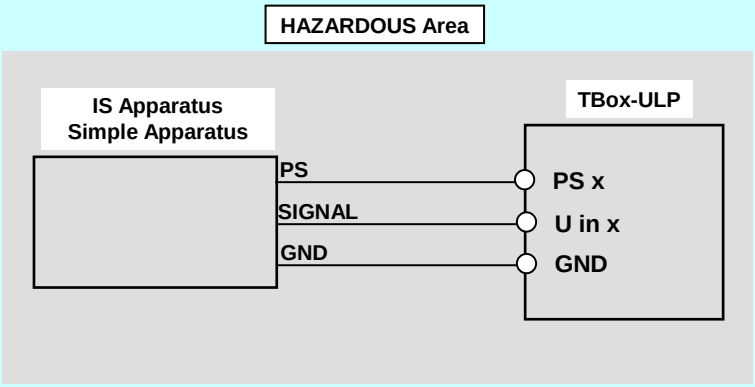
WIRING IN NORMAL ENVIRONMENT

Wiring to 2-wires sensor



WIRING IN HAZARDOUS ENVIRONMENT

Wiring to Intrinsically-Safe Apparatus / Simple Apparatus



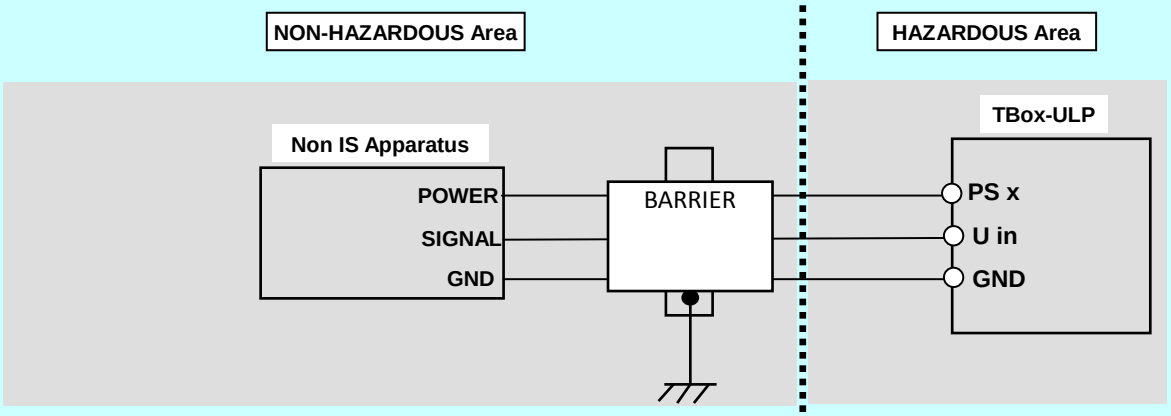
Entity Parameters

TBox WM:		***TBox LP:***	
I in x-GND	**PS-GND**	**I in x-GND**	**PS-GND**
Uo= 8.51 V	Uo= 29.35 V	Uo= 8.51 V	Uo= 29.35 V
Io= 113.3 mA	Io= 181.74 mA	Io= 8.7 mA	Io= 92.65 mA
Po= 241 mW	Po= 1.33 W	Po= 18.44 mW	Po= 680 mW
Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V
Ii= 120 mA	Ii= 100 mA	Ii= 100 mA	Ii= 100 mA
Pi= 881 mW	Pi= 734 mW	Pi= 734 mW	Pi= 734 mW
Ci= 660 pF	Ci= 44 nF	Ci= 1.32 nF	Ci= 88 nF
Li= 0 µH	Li= 0 µH	Li= 0 µH	Li= 0 µH

Analog Input: Voltage Sensor

TBox WM:	***TBox LP:***
U in x + PS - GND	**U in x + PS - GND**
Uo= 29.35 V	Uo= 29.35 V
Io= 204.3 mA	Io= 101.66 mA
Po= 1.5 W	Po= 746 mW
Ci= 44.66 nF	Ci= 89.32 nF
Li= 0 µH	Li= 0 µH

Wiring to Non Intrinsically-Safe Apparatus



Entity Parameters

TBox WM:		***TBox LP:***	
U in x-GND	**PS-GND**	**U in x-GND**	**PS-GND**
Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V	Ui= 29.35 V
Ii= 120 mA	Ii= 100 mA	Ii= 100 mA	Ii= 100 mA
Pi= 881 mW	Pi= 734 mW	Pi= 734 mW	Pi= 734 mW
Ci= 660 pF	Ci= 44 nF	Ci= 1.32 nF	Ci= 88 nF
Li= 0 µH	Li= 0 µH	Li= 0 µH	Li= 0 µH

APPENDIXES

Appendix A. Licenses

The software itself is not protected; it can be installed on any PC and used to develop TWinSoft document (online or offline) and to monitor ***TBox ULP***.

The only operation protected is the sending of an application to ***TBox ULP***.

In order to find the best way for you we offer different possibilities:

A.1. The Evaluation mode

You don't need any software or hardware dongle. You are able to develop a complete ***TBox ULP*** project without any restriction, but when you send the application to ***TBox ULP***, it will stop after 2 hours. This is a good solution for testing programs or creating a demo.

A.2. The Dongle

It is a hardware device placed **on your PC**. The dongle consists in a **USB key**. TWinSoft regularly checks the presence of it. It allows you sending applications to as many ***TBox ULP*** as you want, with any PC.

A.3. The Code (License)

Available from the menu 'Help' → 'License Register.'
Using information of the PC (the Company name, the User name, a Serial Number), you receive a code that you enter in the 'License' field. Once entered, you can send any application as if you had a dongle (see previous).
The only restriction is that it must **always be on the same PC**.
If you wish to use another PC, you have the possibility to remove registration on the first PC and register back on the second.

A.4. The TWinSoft LITE

Available from the menu 'Help' → 'TWinSoft Lite configuration.'
This protection mode is ideal for users having one or two ***TBox ULP*** units. The dongle or a license might be too expensive.
TWinSoft LITE code is linked to one ***TBox ULP***; it allows you sending an application to the ***TBox ULP*** for which you have the code.

Appendix B. Time in RTU

One of the biggest issues in Telemetry and data logging equipment is the handling of time.
In order to have a universal solution, wherever the ***TBox ULP*** is used, TWinSoft, OS of the RTU and 'Windows' collecting data, shares the mechanism of time management.

Time in the RTU is based on UTC time.

B.1. Time in TBox ULP

The RTC (Real Time Clock)

The ***TBox ULP*** is equipped with a RTC chip (Real Time Clock). The RTC is used to manage all internal time.

Functions of the RTC:
- it is a calendar Y2000 compatible.
- it updates the UTC time (see next).
- it communicates with OS to handle the UTC time, used for data logging.

The RTC time is used at start-up of ***TBox ULP*** to update the UTC.

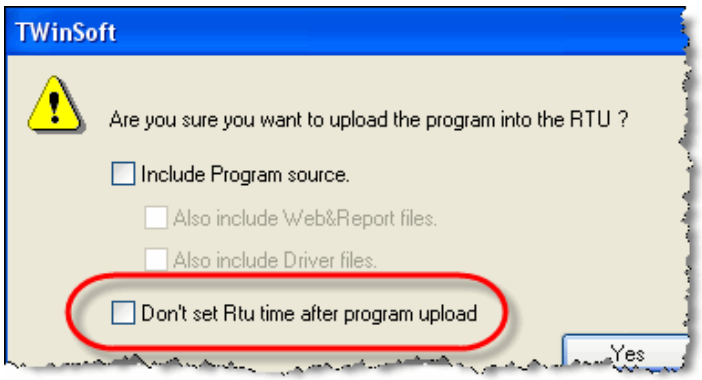
UTC Time

UTC time is based on the number of seconds since 1/1/1970 at Greenwich latitude. It is used as internal timestamp to each event (alarm, chronology, …)
The UTC time is converted into Analog System Variables to give access to time information: second, minute, hour, day, month, year, week.
Changing UTC time automatically updates the RTC.
When time information needs to be sent (in a report, as header of an e-mail, in the Analog System Variable), it is always computed using the UTC time and according to the zone and daylight saving specified in the 'General' RTU properties.

TBox ULP Time setting

In order to set ***TBox ULP*** to PC time, an option is available in the 'Communication' menu of the main menu bar; option available when connected (locally or remotely) to the RTU

When sending an application to ***TBox ULP***, TWinSoft updates automatically the RTU time to the PC time.
This feature can be deactivated from the 'Send application' menu.


TWinSoft
Are you sure you want to upload the program into the RTU ?
Include Program source.
Also include Web&Report files.
Also include Driver files.
Don't set Rtu time after program upload
Yes

RTU time can be checked anytime doing a RTU Identification, from the main 'Communication' menu.

Winter/Summer time

When installed in regions using daylight saving, the ***TBox ULP*** handles the changes automatically.
It means that the **RTC** and **Analog System Variable [hour]** are automatically updated when the time changes.

Standard changing time in Europe:

- last Sunday of October: 3:00 → 2:00
- last Sunday of March: 2:00 → 3:00

B.2. Data logging

Chronologies

In chronologies, the time is recorded for each log of data. The time recorded is the UTC time.
When retrieving the data, the PC reads the UTC time and converts it according to the local time of the PC, depending on the time settings of the PC.
When a winter/summer time change occurs, the ***TBox ULP*** is informed and automatically adapts all coming timestamps to the new time.

Sampling tables

In sampling tables, the ***TBox ULP*** records the timestamp of the last record only. The other timestamps are built up when retrieving the data (from TWinSoft, TView, in report, ...).
A choice had to be made between with period > 1 hour: either having always the same period of recording or having always the same 'hour' of recording. The latter case has been chosen. When a winter/summer time change occurs, the target time is automatically updated for sampling tables having a period > 1 hour.
Example:
If recording a value once a day at 6.00 in the morning, the recording will always happen at 6.00, but when changing from winter to summer, the sampling period will be 23 hours and when changing from summer to winter the period will be 25 hours.

Periodic events

When a periodic event is defined with a period > 1 hour, its target time is automatically adjusted when a changing winter/summer happens.

B.3. System variables associated

Some System Variables of ***TBox ULP*** are associated to the Time. They can be used in Ladder/BASIC logic to execute specific operations:

Type	Variable	Comment
Analog	Second, Minutes, …	6 Registers giving the time in **hour**, **minute**, **second**, **day**, **month** and **year**.
Analog	UtcTim	Time in UTC format (number of seconds since 1/1/1970 at Greenwich latitude)
Analog	ZonBia	Time difference in seconds between the local time and time UTC
Analog	ZonID	ID of the zone where RTU is installed. It uses regional settings of the PC

B.4. Summary

Summary of time handling in the different cases:

1. System variables in the RTU	They display the local time where the RTU is installed, according to the Regional settings declared in the 'General' RTU properties
2. Identification from TWinSoft	The UTC time is computed according to Regional settings of the PC
3. List of alarms in a report	The time is calculated according to RTU local time (see 1. above)
4. List of alarms in TWinSoft	See point 2. above
5. Object 'Time' in WebForm	See point 2. above
6. System variables in WebForm	Displays the value of the variables, as explained point 1. above

Appendix C. Pack & Go

C.1. Presentation

Pack & Go is a tool that builds up one file with your complete project, including TWinSoft document, WebForms, Reports, OS,...

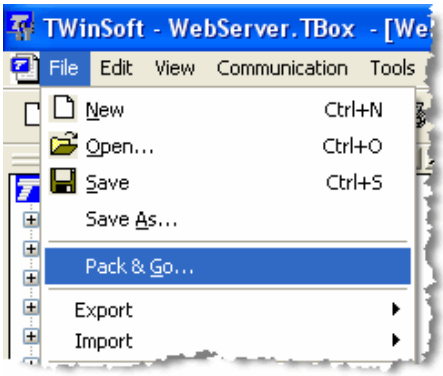
The goal is to **backup** or to **transfe**r a complete project without missing files or to update an RTU with the complete project without requiring advanced knowledge of TWinSoft.

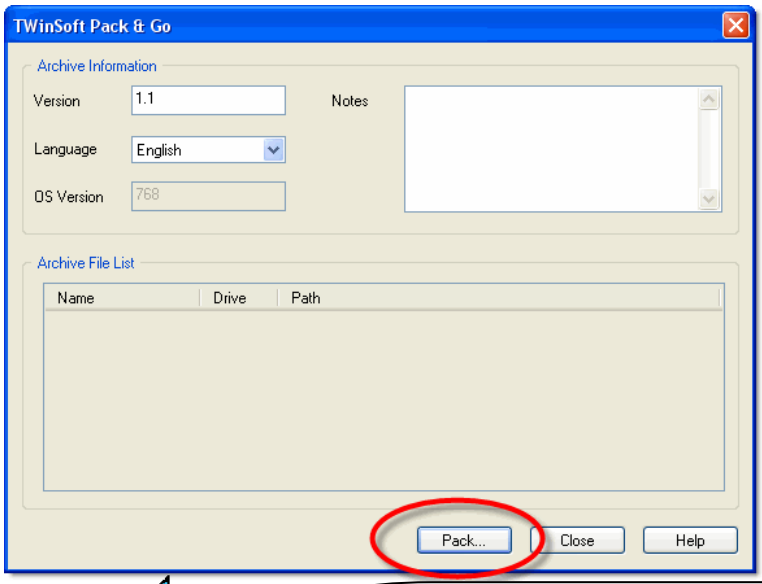
All files are compressed and packed into one file with the extension **.tpg** (TWinSoft Pack & Go).
Once a project is packed, it can be unpacked and/or updated to the RTU from a double click on the **.tpg** file.

TWinSoft **needs to be installed** on the machine used to update the RTU with .tpg file, but the **TWinSoft license is not required**. The license is required to pack.

C.2. Pack

To access Pack & Go menu, select from the main menu 'File' → 'Pack & Go…'

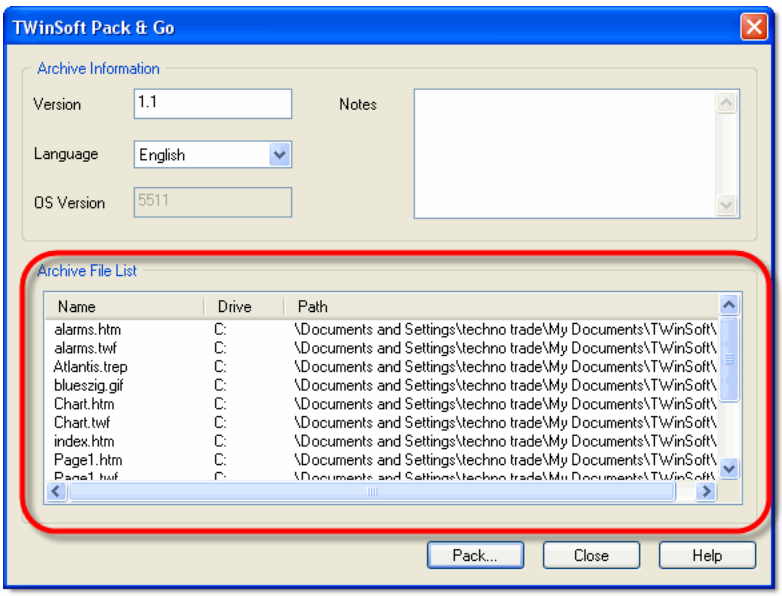




Select the button 'Pack …'

IF YOU ARE OFF LINE while compiling, TWinSoft uses the OS indicated as 'Off line OS' in the 'General RTU properties'. This OS, and only this OS, will be sent to the RTU.

All Files of the project, TWinSoft document, WebForm, html pages, OS, … are packed in one file, with the extension **.tpg**



Be sure the user running the .tpg file runs a version of TWinSoft at least equivalent to the one used to pack the files.

C.3. Unpack

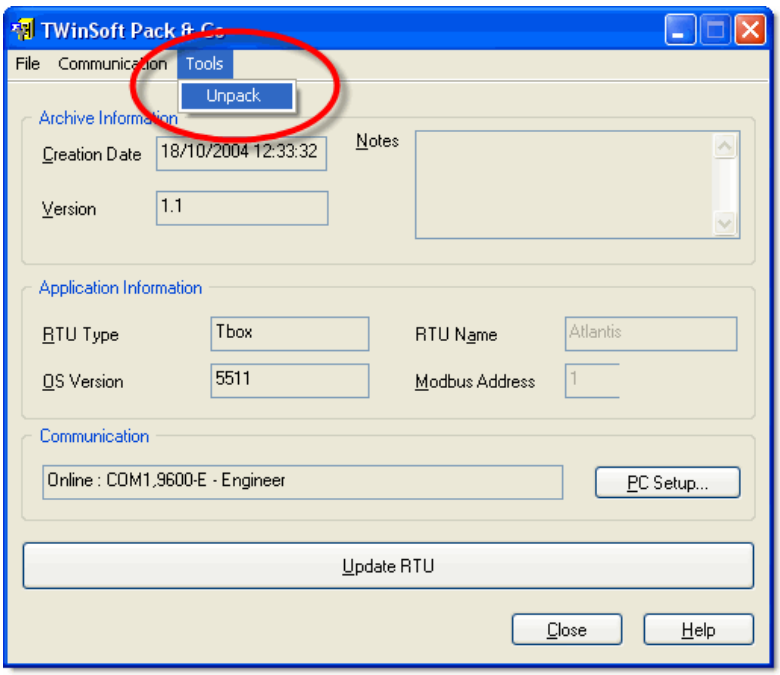
To open the Unpack window, double click a file with the extension **.tpg**.

Unpack menu offers 2 features:

1. Restore a project

Extract a project into a directory of your PC. This option is very convenient for backing up a project being sure you don't miss any file.

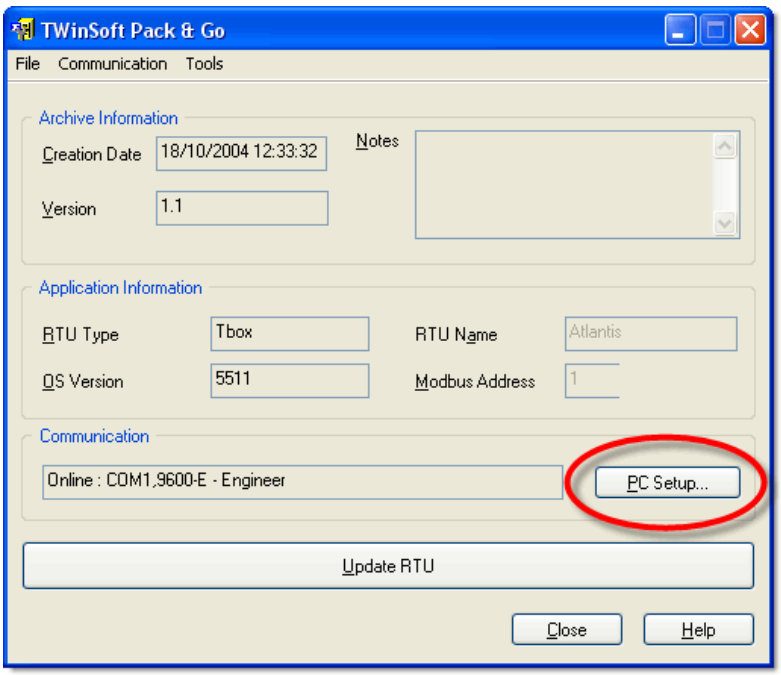
Option available from the main menu: 'Tools' → Unpack.

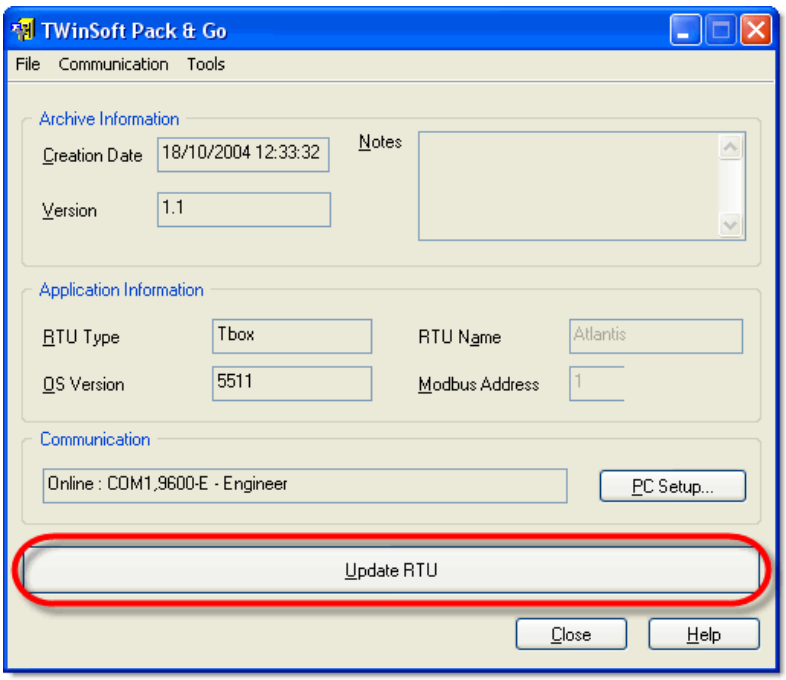


2. Update an RTU

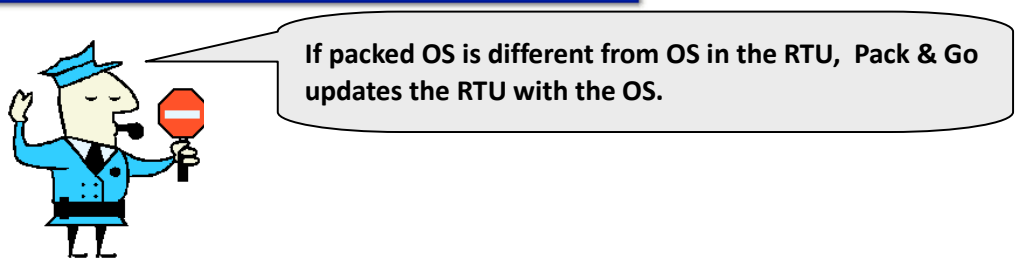
Update an RTU with a complete project, including the application, OS, WebForms, report, ...from a unique file.

The button 'PC Setup…' gives you access to the configuration of the PC, to communicate with the RTU.





The button 'Update RTU' sends the project and OS to the RTU.



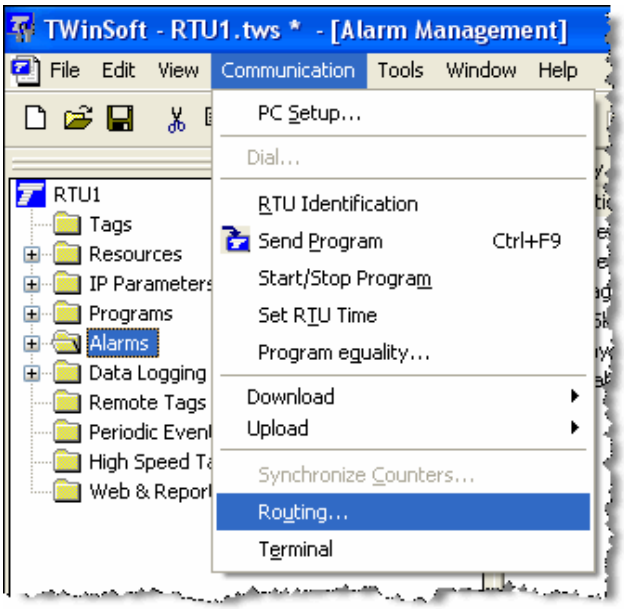
Languages supported are English, French and German.
It cannot be selected from 'Unpack' menu but changed from TWinSoft main menu: 'Tools' → 'Language'

Appendix D. ModBus Rerouting

ModBus rerouting allows associating two 'ModBus-RTU' communication ports, in order to access a remote RTU **with TWinSoft** from your computer by rerouting through a 'Master' RTU.

The typical application, is dialling an RTU to access a remote RTU connected to the RS485 network.

You access routing from the main menu of TWinSoft: Communication → Routing

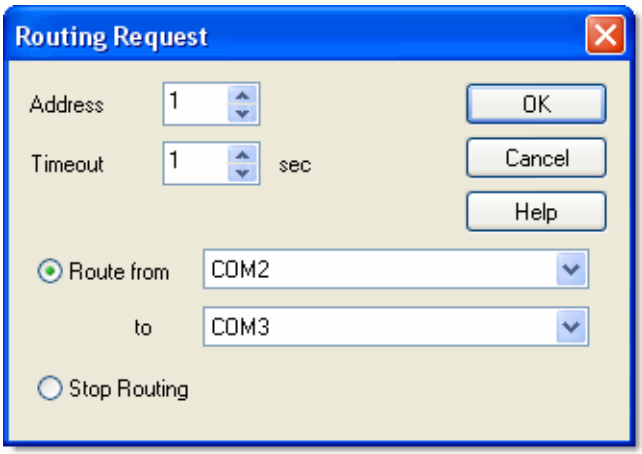


Address: Address of the RTU you are physically connected (the 'Master')

Timeout: Rx timeout used to communicate with the Remote device

Route from: incoming communication port (the port of the 'Master' TWinSoft is connected to)

to: outgoing communication port (the port of the 'Master' connected to the remote device)



Sequence to access a Remote RTU in rerouting:

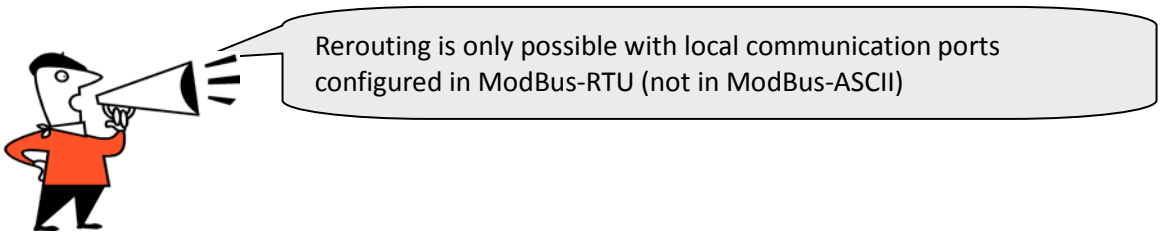
1. Open in TWinSoft the document corresponding to the 'Master' RTU
2. Fill in the Routing request menu as explained above.
3. Open in TWinSoft the document corresponding to the 'Remote' RTU (if you were using modem communication, you will have to redial the "Master").

You are in communication with the Remote Device.

This sequence is only possible when Master and Remote are the **same model of RTU**. If not, you have to pre-configure the Analog system variable (see next)

Analog System variable 'Rerout'

An **analog system variable 'Rerout'** can also be used in your Process to force a rerouting. This 16 bits variable represents 16 communication ports, with the **LSB** corresponding to COM1.
Example: A rerouting between COM2(…000010) and COM3 (…000100) corresponds to the decimal value = 6 (…000110)



Sending a program using Rerouting

For instance, you can send a program by dialing a "Master", and accessing "Slaves" on RS485 network.

Doing a 'local' rerouting, for instance from a RS232 port to a RS485, we recommend using the same Baudrate **on all ports**. If you have 'Remote Tags' running between 'Master' and 'Slave', we recommend stopping them during rerouting, to avoid communication errors.

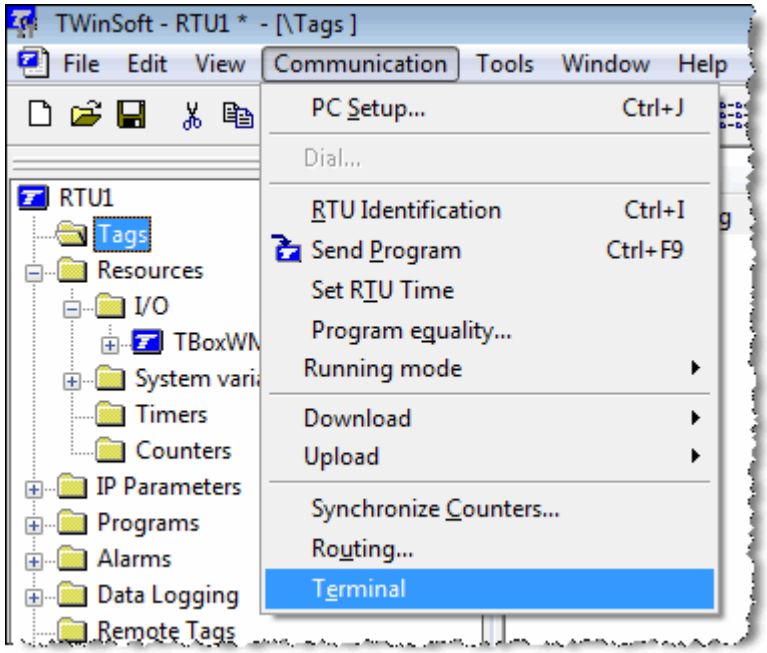
Appendix E. Terminal mode

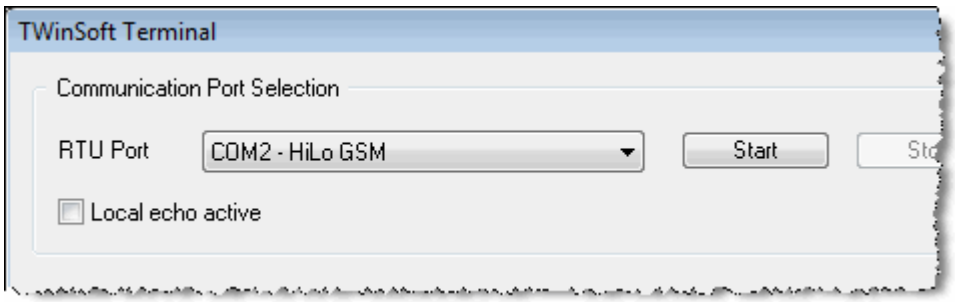
The 'Terminal' mode allows accessing a modem in 'AT command'.

Before starting:

The TWinSoft connection to the RTU **MUST be through COM1 (RS232) at 115200 Bps** (corresponding to the internal Baudrate of the modem).

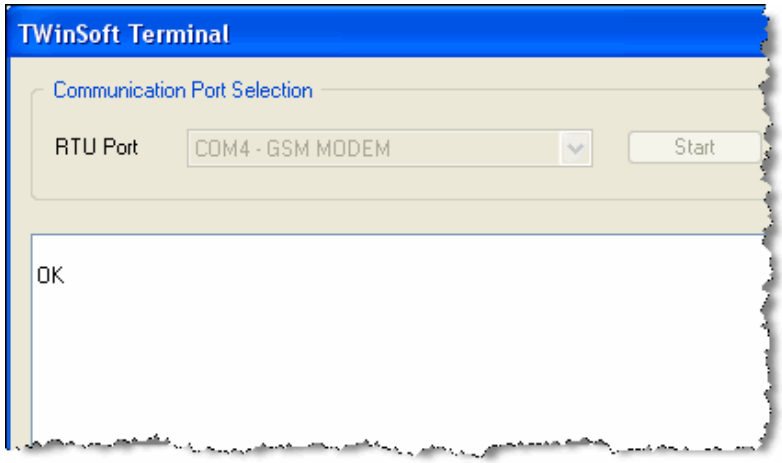
It is available from the menu 'Communication' → 'Terminal':





Example with WM-200-G

Examples of commands to check the availability of a GSM:



To activate the echo in the window, type
ATE1 <ENTER>

(you don't see what you type, it is normal)

The modem answers with
OK

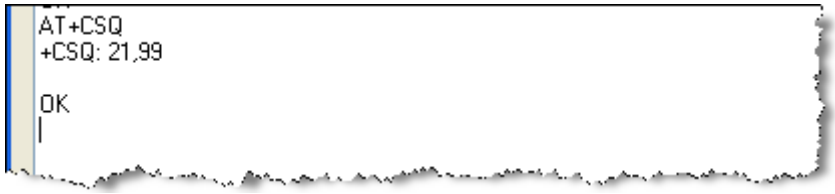
From now on you will see what you type

To check if the SIM card is ready, type
AT+CPIN? <ENTER>

The modem answers
CPIN: READY

To check the GSM operator has been found, type
AT+COPS? <ENTER>

The modem answers with a code or the name of the operator



To check the quality of the signal, type
AT+CSQ <ENTER>

The modem answers
+CSQ:xx,99

xx: must be between 20 and 31

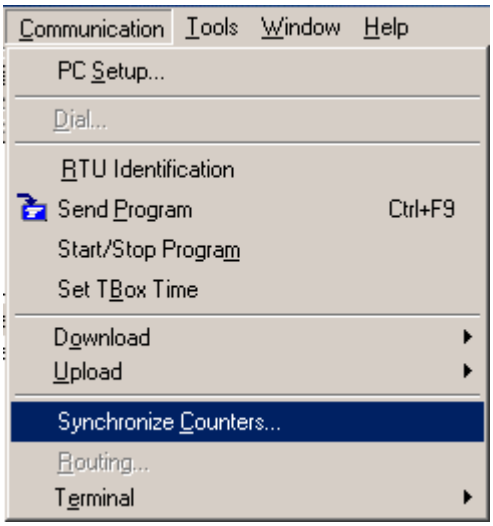
To quit the Terminal mode, click the button "Stop"

Appendix F. Synchronization of Counters

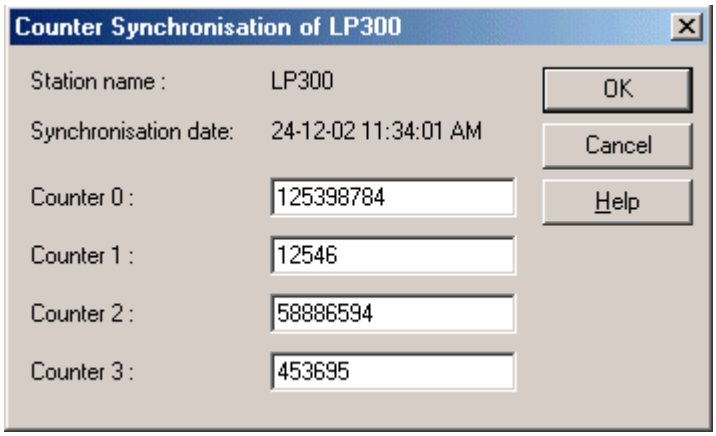
If you use the Digital Inputs for counting pulses, and that a mechanical counter exits on site, you wish to have the equivalence in ***TBox ULP***. On this way, on a simple remote connection you can be informed on the value of the counter.
To each digital input, a 'Totalizer' variable is associated. This variable is supposed to represent the mechanical counter.
After installing the ***TBox ULP*** on site, you will need to synchronize the counter of ***TBox ULP*** to the mechanical counter.

Procedure.

1. Install and cable the ***TBox ULP*** on site.
2. Note the value of the mechanical counter on a paper.
3. Press 'PGM' button. This action memorizes the current value of the counter of ***TBox ULP***.
4. At the office, start TWinSoft and connect to ***TBox ULP***.
5. When connected, open the menu: 'Communication' → 'Synchronize counters'



6. In the list of counters, enter the value of mechanical counter(s) you noted(see point 2 above).



7. The registers of ***TBox ULP*** are now updated to the value of the mechanical counter + the number of pulses since the moment you pressed 'PGM'.

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